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LECTURES

ON

THE NERVOUS SYSTEM

AND

ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c., &c.

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" Il est peu de découvertes de quelque importance que *l'envie* n'ait tenté d'enlever à leurs véritables auteurs pour les placer sous un nom étranger ; tel est l'esprit humain. Jenner a eu sous ce rapport le sort de tous les inventeurs. *Quand il annonça la vaccine, on le traita de visionnaire, et quand il l'eut démontrée, on prétendit qu'elle était connue de temps immémorial——dans les Indes Orientales!*"

" Il ne suffit par d'entrevoir confusément une vérité nouvelle pour prétendre à l'honneur d'y attacher son nom : *la vérité appartient à celui qui l'établit solidement, qui l'étend, la développe, la féconde.*"

Bousquet, de la Vaccine, p. 1—4.

PREFACE.

1. Having at length, Gentlemen, brought to a conclusion my observations on the nervous system and its diseases, so far as my present space will allow, I have now to make a few remarks, relative to the place which my investigations ought to occupy in the history of physiology.

2. If I advert to this subject once more, it is because an elaborate attempt has been made to deprive me of the credit due to originality in my investigations,—how vainly you will soon perceive.

3. I will not inflict upon you a refutation of these articles seriatim, which, so far as I am concerned, it would be most easy to write. I will make such observations only as are necessary to elucidate the question before us. In one journal there are two articles, *both* in opposition to me, which *actually contradict each other*. One of these articles deems my observations of sufficient importance to be claimed for Haller, Whytt, &c. &c. The other views them as so novel and dangerous as to require that the student should be warned against them! Dr. Pnris observes, in his "Life of Sir Humphry Davy,"—"If a discovery be made, its truth and importance are *first* questioned; and should these be established, *then* its originality becomes a question of dispute." It was left for the writers in that Journal to endenvour to accomplish *both* of these objects *at once!* Never did such a glaring instance of inconsistency disgrace medical literature. I corresponded with the editors upon the subject. Did they, in consequence, make an honourable "amende?" No. The self-contradiction, without correction, without apology, remains,—remains sanctioned by their names! And these gentlemen speak of vindicating the *honour* of our profession! Let them first wash their hands of a publication, of which *part might*, but of which *all could not*, be true, or just, or honourable.

4. You may, perhaps, be amused by comparing and contrasting a paragraph or two:—

"These are phenomena to which Dr. M. Hall has given the rather uncouth name of 'excito-motory,' and which he states as the effects of the 'reflex function of the spinal chord;' a power neglected or misunderstood, as he thinks, *by former physiologists*, &c.

"It cannot be necessary to remind our readers of the great class of movements," &c.

"Dr. M. Hall cannot be ignorant of the statements and reasonings by which Dr. Whytt," &c.

"The only truly original observations which we have noticed in the work of Dr. Hall," &c.

"We cannot admit that we owe to him the knowledge of this principle," &c.

Here the thing is *good* but *old!*

"*We* protest (!) in the strongest manner against the introduction into this work (On the Nervous System, by F. Le Gros Clark), of certain physiological views, which are anything but well established" (!) by Dr. Marshall Hall. "Mr. Clark is almost the *only* anatomical writer who appears to have received these ingenious views without some distrust of their correctness," "unconfirmed as they are by *any other physiological authority*." (!)

"Instead of rendering the knowledge of the nervous system more intelligible to the student, it will rather tend to confound and perplex him." (!)

Here it is *new*, but *good for nothing!!*

5. There is no *consistency* in those statements, *except* that of their opposition to *me*.

Let me repeat, from § 289, what has been done by my own investigations. I have shown you, then,—

I. That the vis nervosa of Haller obeys other and different *laws* from those laid down by that eminent physiologist, and by Professor Müller.

II. That this same power is the active but *unsuspected* agent in the experiments of Redi, Whytt, Legallois, Mr. Mayo, &c.

III. That this same power has a most extensive but *unsuspected* application to *Physiology*, *Pathology*, and *Therapeutics*; and

IV. That it reposes in a special and *unsuspected Anatomy*, consisting of

1. *The True Spinal Marrow*, with
2. *Incident*, *Excitor*, and
3. *Reflex*, *Motor Nerves*.

V. These constitute the *True Spinal Excito-Motory System*, the importance and extent of which no one yet knows. *These constitute my discovery.*

More or *less* than these I do not claim.

6. Now, nothing which the Reviewer adduces interferes with that statement. I freely grant him all he would take; and still I assert that the statement to which I have alluded is true in all its parts.

7. But in another number of the same

publication there is another (yea, and another! yea, and another!) article against me! The first is headed—

"*Complete Anticipation of Dr. Marshall Hall's Doctrine of the 'Reflex Function,' by Prochaska.*"

8. A very youthful critic observes upon this author,—"I know not whether I have been more surprised at *the accuracy of his views*, or the fact of their having been *so long overlooked*."

9. Whether Prochaska's observations be a "complete anticipation" of my doctrines, and whether his views be of such surprising "accuracy," you will soon see and judge for yourselves. But before I proceed to lay these observations and views before you, I will *explain* the fact of their "having been so long overlooked." The truth is, that until the development of that "harmonious combination of these doctrines into a uniform system, and the application of it to the explanation of many phenomena which were not formerly regarded as explicable on such principles, in which," according to one of my reviewers, my "great merit consists" (and in this sentiment I am myself disposed partly to concur), neither this youth, nor any one else, had *eyes to see* the full value of these things. I will lay before him another extract from the work already quoted of Dr. Paris: *he* is young, and though pert, *may be* ingenuous:—

10. "Evidence may be often strained from the writings of philosophers in support of prior claims to late discoveries; but upon a candid review, these loose statements, or obscure hints, will generally be found wholly destitute of the pretensions which an unfair spirit of rivalry has too often laboured to support. Many of such hints, indeed, so far from advancing the progress of truth, *had never even attracted notice, until* AFTER *the discoveries to which they have been supposed to relate.*" (!)

11. I will now inform you that for *four* years, viz., from 1832 to 1836, those views (and nothing more than the term *reflex*) whose value he estimates so justly, but which he would so unjustly assign to Prochaska, and some other ancient writers, were treated with neglect, nay, with ridicule. No one thought them worth claiming for himself or for others. It is only within the last *two* years, when the value of my researches could not longer be concealed, that they have obtained notice, and, at the same time, been claimed by some for themselves, and by some, for others.

12. But I proceed to lay before you this extract itself:—

"CHAPTER IV.

"*Functions of the Sensorium Commune.*

"§ 1. What are the Sensorium Commune, its functions, and its seat?

"1. External impressions which are made upon the sensorial nerves are propagated very rapidly through their whole length to their origin, where, when they have arrived, they are reflected according to a certain law, and pass into certain responding motor nerves, through which they are again propagated to muscles, and excite certain and determinate motions. This place, in which, as in a centre, the nerves appropriated to sense as well as motion, meet and communicate, and in which the impressions of the sensorial nerves are reflected upon the motor nerves, is called the Sensorium Commune,—a term already received by most physiologists.

"2. It is not *one place* in which celebrated men have placed the seat of the sensorium commune. Bontekoe, Lancisi, de la Peyronie, have placed the sensorium commune the corpus callosum. Willis places the perception of the senses and the origin of motion in the corpora striata: Descartes attributed the function of the sensorium commune to the pineal gland; Vicussens to the centrum ovale; Boerhaave considered that collection of points as the sensorium commune, in which all the sensorial nerves terminate, and from which all the motor nerves arise, and places it in the medulla (fornicata), surrounding the cavity of the ventricles; in a later work, however, he placed it in the confines of the medullary with the cortical substance, which opinion the illustrious Tissot regards as the most probable, and proved by the observations of Wepfer; Mayer seems to place the sensorium commune in the medulla oblongata, and of this opinion is Metzger; Camper says,—'If the sensorium commune has any locality it is in the pineal gland, the nates, and the testes, and that the opinion of Descartes is not a foolish one.'

"The *whole cerebrum* and *cerebellum* certainly do not seem to belong to the sensorium commune. (!) These parts of the nervous system appear to be rather the instruments which the soul uses immediately in the performance of the actions termed animal; but it seems not improbable that the sensorium commune, properly so called, *extends* to the medulla oblongata, the *crura cerebri*, and *cerebelli*, (!) to part of the *thalami* optici, (!!) and the whole spinal marrow; in a word, to the origin of the nerves. That the sensorium commune extends to the spinal marrow, we learn from the motions which remain in decapitated animals, which could not take place without the consent and co-operation of nerves arising from the spinal marrow; for if a decapitated frog be pricked, not only is the punctured part retracted, but it crawls and leaps, which could not be without the consent of the sensorial and motor nerves, of which consent the seat must be in the spinal marrow, a part of the sensorium commune remaining.

"3. The reflexion of sensorial into motory

impressions, which takes place in the sensorium commune, does not obey mere physical laws, where the angle of reflexion is equal to the angle of incidence, and where action and reaction are equal; but peculiar laws written, as it were, by nature, in the medullary pulp of the sensorium, which we can only know by the effects, and not discover by our imagination; but a general law, according to which the sensorium commune reflects sensorial impressions, is our preservation; so that certain external impressions, hurtful to the body, are followed by certain motory impressions, producing motions tending to remove the source of injury; and, on the contrary, external or sensorial impressions, beneficial to us, are followed by internal or motor impressions, producing motions calculated to perpetuate that benefit. Many examples certainly prove this general law of reflexions of the sensorium commune, of which it will be sufficient to adduce a few.

"Irritation of the internal membrane of the nostrils excites sneezing, because that irritation made upon the *olfactory* nerves is carried to the sensorium commune, is there reflected, according to a certain law, upon motor nerves going to the muscles appropriated to respiration, and, through these, produces a forcible expiration, by which the irritation is removed. In the same manner, when any irritation is caused to the larynx by a crumb of bread or a drop of liquid, this irritation, carried to the sensorium commune, and thence reflected upon the nerves appropriated to respiratory motion, excites a forcible cough, the most apt remedy for expelling the irritant, which does not cease until that irritant is removed. If a person approaches our eye with his finger, although we are persuaded that no harm will be done to us, yet that impression carried by the *optic* nerve to the sensorium commune, is so reflected, in the sensorium, upon the nerves appropriated to the motion of the eyelids, that we involuntarily close the palpebræ, so as to avoid the contact of the finger. (!) These, and innumerable other examples that might be adduced, show manifestly how much the reflexion of sensorial into motor impressions by the sensorium commune regards the preservation of our body. On this account Tissot properly enumerates the action of the sensorium commune amongst those powers which constitute the nature of our living body.

"4. As, therefore, the principal function of the sensorium commune consists in the reflexion of sensorial into motor impressions, it is to be observed that this reflexion takes place whether the mind be conscious or unconscious of it. The motion of the heart, (!) of the stomach, (!!) and of the intestines, (!!!) certainly in no respect depend on the consciousness of the mind; but as no muscular motion can be excited unless a stimulus applied to the sensorial nerves passes by a certain reflexion to the motor nerves, and excites contraction of the muscles, so it is certain that the reflexion of impressions proper for inducing these motions, if they take place in the sensorium commune, take place without the consciousness of the mind. But it is asked whether these impressions ascend to the sensorium commune, to be reflected, or whether, without making this circuit, they are reflected by the ganglia, whence these parts have many nerves. More on this point hereafter. But that the reflexions of sensorial into motor impressions take place in the sensorium commune, we learn from certain actions in apoplectic patients, in whom all consciousness is destroyed; for they have a strong pulse, (!) breathe, and even raise the hand to the part affected (!!) unconsciously. The sensorium commune acts also without consciousness in producing the convulsive motions of epileptic patients, and even those motions which are observed in profound sleep, besides motion of the heart and respiration, viz., of the limbs when slightly punctured, or pricked, or pinched. To these we must add all those motions which remain in the body of a decapitated man, or other animal, and are excited by pinching the body, but especially the spinal marrow, which certainly occur without consciousness, and from the residual part of the sensorium commune, which is in the spinal marrow. All these actions arise from the organisation and physical laws proper to the sensorium commune, and are, therefore, spontaneous and automatic. Those actions which take place in the animal body with consciousness are such, that the soul has no power over the will, or such as the soul can coerce or impede at will. The former, as they are ruled by the sensorium commune, as far as it does not depend upon the mind, also not less than those which are performed unconsciously, are automatic. Such are sneezing from a stimulus applied to the nostrils; cough from a stimulus applied to the trachea; vomiting from irritation of the fauces, or from an emetic; tremor and convulsions in chorea, S. viti, and in the paroxysms of intermittent fever, &c. But the actions which the soul directs and moderates by its power, although the sensorium commune has its part in producing them, we call, nevertheless, animal, not automatic. Of these we shall treat in the next chapter."

13. I have numbered the paragraphs for the sake of easy reference.

You will soon discover that it is no "anticipation" of my peculiar views whatever, and far, very far, from being of extraordinary "accuracy."

14. First for par. 1. This is certainly a step beyond Whytt; but is it a "complete anticipation" of *my* DEMONSTRATION, and of

the *true spinal* SYSTEM? (See particularly these lectures, § 52, &c. &c.) Green-eyed, indeed, must that person be who will affirm this. But—

15. Now for par. 2. What do you think of this as a "complete anticipation" of my discovery of

1. *A distinct and true spinal marrow, the exclusive centre of*
2. *A system of incident, excitor, and of reflex, motor nerves, and the exclusive seat of*
3. *The excito-motory power, exclusive of the cerebrum, cerebellum, and cerebral nerves?*

What do you think of the surprising "accuracy" of these views?

16. And now for par. 3 and 4. *I* have strenuously endeavoured to show the distioction between

1. *The cerebral,*
2. *The true spinal,* and
3. *The ganglionic systems.* See § 4, 21, 83, &c.

Here all are confounded. The raising of the hand of an apoplectic patient to his head; winking on the *approach* of the finger to the eye; the action of the heart, stomach, and intestines; and, in another place, the growth and nutrition of the fœtus, are all enumerated pell-mell with actions which really belong to the true spinal system. The questions I would ask are these:—Where is the "complete anticipation" of my discovery of *the excito-motory system, the exclusive system of—*

1. *The orifices, the sphincters;*
2. *The ingestors, the expulsors;* and, in a word, of
3. *All ingestion and egestion* in the animal frame, and economy?

Where is the "anticipation" of this SYSTEM? Where is the "accuracy" of these views?

17. I would ask further—Where is the "complete anticipation" of my discovery of *the system of the* WHOLE CLASS *of spasmodic diseases:*

1. *Centric;*
2. *Centipetal;* and
3. *Centrifugal?* (See § 966.)

Other questions crowd upon me. Where is the demonstration that the power in all this combined system is the *vis nervosa* of Haller, acting in modes and directions never suspected before by any writer, and at direct variance with the most explicit statements of that eminent physiologist and Professor Müller. (See § 27.) I put this question in the face of the feeblest of all feeble attempts to deprive me of the merit of having first proved this fact and law, made by my reviewer.

18. What shall I say of my remarks respecting the action of *remedies*, the condition of the *larynx* in different spasmodic diseases, the condition of the *muscles* in paralysis, &c. &c.? Where—where is the "complete anticipation" of all this?

19. You cannot imagine, Gentlemen, how sickening this altercation is to me. But Harvey and Haller, and even Jeoner, experieoced similar treatment, and, if possible, worse. It is my duty to state the truth, and from this duty I shall not shrink. I am sorry for the gentlemen who have put forth this "complete anticipation," these "accurate views," but I affirm that I grant them williogly all that the paragraph contains, without feeling that I have sustained the loss of one jot or one tittle of what I have claimed for myself. Again I refer you particularly to § 6 of this preface, or § 289 of these lectures.

20. I have now the painful duty of stating that a writer in another Journal has even insinuated that I had read this paragraph in Prochaska, and that I had taken the work out of the library of the Medico-Chirurgical Society, of course for this purpose! Now, I can affirm that I never saw Prochaska's volume in my life, until *years* after I had published my "Memoir on the Reflex Function of the Medulla Oblongata and Medulla Spioalis," in 1833. The author of the statement in question might, if truth and justice were his objects, have readily assured himself of this fact, so far as the copy belonging to the Medico-Chirurgical Society is concerned, in *the same manner* in which he ascertained that I had used that copy at all. There are not, I should think, many other copies of Prochaska in London, and, at any rate, I defy friend or foe to prove that I ever saw one. When I did consult Prochaska it was to read the passages quoted from him by Sir Charles Bell, in preparing the first edition of these lectures, published in April, 1836. And that it was so, and that I had no wish to conceal Prochaska's name, is proved by the facts of my having mentioned it *twice*, and copied *two* drawings from his work upon those points, in *one and the self-same page* of this Journal. (See § 22—24.)

21. But I will give this base insinuation in the very words of the writer; they are as follows:—"There is a copy of Prochaska's work in the library of the Medical and Chirurgical Society, and little as the volume was known to others, one member, at least, has shown that he duly appreciated its value, by the fact of his having repeatedly taken it out: that member, need we add, is—Dr. Marshall Hall!"

22. I have done what the author of this calumny ought to have done before he indulged himself in an unfounded insinuation, viz., corresponded with the librarian of the said Society; and I present you with a copy of the correspondence:—

"14, Manchester-square, April 13, 1838.

"Dear Sir,—Will you do me the favour (though I fear I am giving you much trouble) to inform me on what occasions I have had

Prochaska's works from the Medico-Chirurgical Society's library?

"As your note is for the purpose of publicatiou, I will thank you to let it be very short, but *full* and *explicit*. I am, dear Sir, yours very truly,

"MARSHALL HALL.

"To Mr. Williams, Librarian, Medico-Chirurgical Society."

"Royal Medical and Chirurgical Society,
"April 14, 1838.

"Sir,—In reply to your inquiries, I beg leave to inform you that you have taken from the library Prochaska's works on the following dates: December 30, 1835; January 30, 1837; January 20, 1838. I have the honour to be, Sir, your obedient servant,

"Thos. Williams, Assistant Librarian.

"To Dr. Marshall Hall."

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23. Now, my *first* paper "On a Particular Function of the Nervous System," was read to the Zoological Society on the 27th of November, 1832; and my "Memoir on the Reflex Function of the Medulla Oblongata and Medulla Spinalis," was read to the Royal Society on June 20th, 1833; the former upwards of THREE YEARS, the latter TWO YEARS AND A HALF before the FIRST of the dates on which I consulted Prochaska.

24. If I *had* seen the passage which is so 'complete" an anticipation of my doctrines, and so "accurate" in its views, which I never did, it is more than probable that I might have passed it over, or, at least, have classed it with the vague statements of Whytt and *his* "partizans." For, in fact, it is little better than vague, except in the single word "reflectuatiou," a term which I have almost exchanged for the term excito-motory; see the *title* of my last Memoir.

25. But what is more important is, that I can fortunately *prove* that the process by which I arrived at the discovery of the *True Spinal System*, was different from that insinuated above, and independent of Prochaska, or of any one.

26. My friend Mr. Henry Smith, of Torrington-square, was present when the phenomenon which suggested this system to me was first observed *incidentally*, and during nine-teuths of the whole series of my experiments.

27. The fact to which I have alluded, was the movement of the separated tail of the salamander, on the applieation of the point of a needle. Similar phenomena were then observed in other parts of the same animal. The head being first removed, and the trunk then divided. After irritating various parts of the *skin*, the next step was to irritate the *mucous surfaces*, and then to pursue the subject in all its exteusive relations to anatomy, physiology, pathology, and therapeutics.

28. I have stated that the fact first observed, was observed incidentally. It was observed in the course of my researches on the circulation of the blood, during which I was constantly joined and assisted by Mr. Smith, as my dedieation to my work upon that subject expresses.

29. Mr. Smith can bear testimony, not only to these facts, but to the whole process of reasoning and experimeut to which it led. The *whole* was a pure discovery, or series of discoveries, on my part. When I afterwards learut what Redi, and Whytt, and Legallois, and Mr. Mayo had done, I adopted it at once as theirs, as I now do the statements of Prochaska, so far as they are in accordance with truth.

30. I have thus proved,—

1. That I never saw Prochaska's work until three years after my first paper was published.

2. That if I had, it does not contain the *principle* or the *theory* of the true spinal system.

3. That my views were formed entirely from an independent observation and a subsequent series of experiments.

31. And once more I repeat that I claim nothing which is to be found even in Prochaska. Again I request you to read § 289, or § 6 of this preface, and to compare it with the extract from that author. Not ONE of the points of my recapitulation is to be found in this "complete anticipation" of my doctrines!

32. I am sorry that I must now add that I consider the account of my young critic as being unfair. If you have time and inclination, read and compare carefully his recapitulatiou with the references which he gives you, on the one hand, and with mine, on the other, and judge for yourselves. I have only space for an example or two: first, the assertion "*exclusirely of the cerebrum and cerebellum*," is not correct; for the crura of both, and part of the thalami are *included*; secondly, the phrase "*vis nervosa of Haller*," is incorrect, for it is not the vis nervosa *of Haller*, as I have understood and used it, which is meant, for this does not regulate formatiou and nutrition in the fœtus; thirdly, the phrase "*the Class of spasmodic diseases*," is incorreet, for such a collective phrase has not been used by any one, I believe, but myself; &c. &c. This youth would have done better and more wisely, as well as justly, to have kept *within* the bounds of truth, instead of passing them. How will *you*, who have *heard*, and *seen* the *development* of the True Spinal and Excito-motory System, in all its length and breadth, smile when you observe that he writes *thus* of the paragraphs from Prochaska and the other worthies:—"The *principle* itself, the *seat* of its action, and the *theory* having been developed!" &c. Whether my labours be original or not, I can assure this critic that *his* are not. Every piece of scientific biography presents examples of envious detraction. The unfortunate and amiable La-

voisier was not spared: "on déterrait," says the eloquent Cuvier, "pour le chagriner, tous les vieux livres, ou pouvaient se trouver quelques idées analogues aux siennes."—(Eloges, 1827.)

34. You might think, Gentlemen, that I have now surely done, but it is not so. With the gentlemen already noticed, I *must* class an *assassin writer* in an "evening paper." I copy the following paragraph from the "Times:"—

"Dr. Marshall Hall has within the last few days performed a series of experiments on a turtle which had unfortunately fallen into his power, with the view of demonstrating to his class the nature of the nervous influence. When experiments are made with the view of illustrating a disputed point which has a direct bearing on any subject connected with the science of medicine, however much we deplore the necessity of such proceedings, we cannot condemn the operator; but surely those experiments ought not to be made merely to gratify idle curiosity."—*Evening Paper.*

34. This paragraph had reference to the experiments published in THE LANCET, vol. I. p. 166. The reply was obvious. It occupied a prominent situation in the first page of the "Times" a few days afterwards:—

"EXPERIMENTS UPON A HEADLESS TURTLE,
"*To the Editor of the Times.*

"Sir,—I have just seen in your paper of this morning a paragraph extracted from an evening paper which, if the insinuation it contains were true, would be, and very justly, injurious to me. The evening paper forgot a material point. *Before the turtle came into my possession it was* HEADLESS—*had ceased to be a sentient being!*

"One of my objects in these researches is the very opposite to the ignorant and unjust insinuation of the evening paper. I have observed,—'It may be satisfactory to the humane to know that the motions of the eel, for example, after the head is removed, are not motions arising from *sensibility*, but from another principle, as distinct from feeling as the irritability of the mere muscular fibre. This fact will suggest the means as well as the propriety of avoiding such monstrous cruelty as that of skinning eels alive. This will be effectually done by first removing the *head* however the animal may afterwards move on the application of stimuli, and *appear to feel.*'—(Memoirs, p. 38.)

"I trust the editor of the evening paper will, when he sees these lines, have both head and heart enough to correct the impression his paragraph must have made upon his readers. I am, Sir, your obedient servant,

"MARSHALL HALL."

35. The whole conspiracy presents a deplorable view of the jealousy and malignity which prevail amongst the soi-disant guardians of the honour of our profession! I do not believe that the history *even of physiology*, to which I now add a melancholy page, exhibits such a disgraceful picture.

36. Finally, what shall I say of the *host* arrayed against me at this moment? Merely that I *know* what breasts feel the bitterness of disappointed malignity, and what breast feels the glow of conscious truth, justice, integrity, and honour, yea, and of a true though abused benevolence.

37. Much has been said respecting the terms used in a recent controversy. My opponents forget that all improper phraseology employed by me consisted of *quotations* from their protégée. For instance, "decided misrepresentations," "suppression of facts," "statements not in strict accordance with facts," are always disclaimed, being carefully marked with inverted commas.

38. Much also has been said respecting the introduction of what have been termed "*private* matters" into this controversy. I beg leave to say that I have introduced no private matters. I assisted the party alluded to to the very uttermost, when a total stranger, upon a purely *public principle*, just as I would any other apparently deserving member of our profession; and upon a similar principle, and as a *public duty*, when he aspersed my character unjustly, I exposed his calumnies, his plagiarisms, and his ingratitude together. And, as I *never* had any feeling of *friendship* towards him, so now I have not the slightest feeling of *animosity*. It is *pity*, *not anger*, which I feel towards him, and all who can sanction such disgraceful conduct as his.

One journal states, another repeats, and the former eagerly and noisily re-echoes, charges against me, which are totally unfounded, whilst they have evaded the *real*, the *scientific* question, and the questions—Who is a *plagiarist?* and who is a *faithful historian?* (See § 15, 16, 503, &c.) Whether all this be worthy of our profession and our literature, I willingly leave to your judgment.

39. And wherefore all this opposition? One fact will explain the mystery. I have gladly availed myself, for the dissemination of these important views, of the widely-diffused circulation of THE LANCET!

40. I feel that I have done the science and the art of medicine some service by my last ten years' labours. I feel that my claims have been unjustly opposed by individuals at the Royal Society, and elsewhere; but to my brethren in the profession at large, I have to express my warmest thanks, for the *daily* testimony I receive of *their* estimation of the value of my investigations. With *their* countenance and assistance, I will pursue my useful labours, *regardless*, henceforth, of every obstacle which envy, hatred, and malice may invent and oppose.

LECTURES ON THE NERVOUS SYSTEM, &c.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

Lecture I.

Gentlemen:—The moment is now arrived when I must introduce to your notice the subject of the Nervous System and its Diseases. In doing this, I must necessarily treat at length of my own labours in this department of science and of medicine. It has been my fortune—I cannot, at present, call it my happiness—to have discovered and developed a principle of action equally new and important, and of most extensive application to the physiology and pathology of the nervous system. It is my duty to unfold to you this and the other principles of action in the nervous system.

2. The nervous system has hitherto been subdivided into *two*:—

I. The *Cerebro-spinal*, and

II. The *Ganglionic*, or *Sympathetic*.

3. I shall very soon have occasion to explain to you that the designation, *cerebro-spinal*, is erroneous, and conveys an incorrect idea. It should be simply *cerebral*, that part of the spinal marrow connected with this part of the nervous system consisting merely of the fibres of the cerebral nerves; whilst the true spinal marrow constitutes another and distinct system, of which I shall, from its recent detection, have to treat at great length.

I. Of the Cerebral, or Sentient and Voluntary System.

4. The cerebro-spinal subdivision of the nervous system, or, as it would be more correctly designated, the cerebral, is the system of *sensation* and *volition*. It is the system by which we are connected *intellectually* with the external world. It is that by means of which we feel and perceive external objects, and by which we approach them and appropriate them to our use exteriorly. My fingers being in contact with this book, I feel, I perceive it, and, by an act of volition, I raise it from the table. This apparently simple operation requires *three* portions of anatomy.

5. 1. Certain nerves must proceed continuously, uninterruptedly, *from* the points of my fingers *to* the cerebrum, the centre of this system;

2. The cerebrum must be in a state of integrity; and,

3. Certain nerves must proceed *from* the cerebrum *to* the muscles which are to be called into action.

6. Upon the cerebrum the immaterial and immortal soul sits enthroned, receiving the ambassadors, as it were, from without, and sending forth its emissaries and plenipotentiaries, which convey its sovereign mandates to the external world.

7. There are, then, *two* sets of cerebral nerves; at least there are cerebral nerves having *two functions*. This was distinctly known to Galen. To anatomists it has long been known that the *fifth* cerebral nerve, or the *trifacial*, and *each* spinal nerve, has *two roots*. To Sir Charles Bell the truly splendid idea first occurred, that, as each of these nerves had two functions and two roots, one of the roots might be destined for one of these functions, and the other for the other. This conjecture has been confirmed by experiment. To its great discoverer, Sir Charles Bell; to Mr. Shaw, the brother-in-law, and to Mr. Mayo, the familiar pupil, of Sir Charles Bell, in this country; to Sig. Bel-

lingeri in Italy, and M. Magendie in France, the investigation of this physiological principle, is greatly indebted; it has been completed by Professor Müller.

8. I shall not attempt, at present, to determine the precise degree of merit of each of these physiologists. *None* can rank as a discoverer, in the sense in which I affix that elevated title upon Sir Charles Bell; whereas *all* possess the merit of *pursuing* an inquiry which that distinguished physiologist *originated*.

9. Nevertheless truth compels me to state, that Sir Charles Bell's experiments were defective, and his proof of his own doctrine deficient. He observes, "After delaying long on account of the unpleasant nature of the operation, I opened the spinal canal of a rabbit, and cut the posterior roots of the nerves of the lower extremity. The creature still crawled, but I was deterred from repeating the experiment by the protracted cruelty of the dissection. I reflected, that an experiment would be satisfactory if done on an animal recently knocked down, and insensible; that whilst I experimented on a living animal, there might be a trembling or action excited in the muscles by touching a sensitive nerve, which motion it would be difficult to distinguish from that produced more immediately through the influence of the motor nerves. A rabbit was struck behind the ear, so as to deprive it of sensibility by the concussion, and then I exposed the spinal marrow. On irritating the posterior roots of the nerve, I could perceive no motion consequent in any part of the muscular frame; but on irritating the anterior roots of the nerve, at each touch of the forceps, there was a correspondiug motion of the muscles to which the nerve was distributed. Every touch of the probe, or needle, on the threads of this root, was attended with a muscular motion as distinct as the motion produced by touching the keys of a harpsicord. These experiments satisfied me that the different roots and different columns from whence those roots arose, were devoted to distinct offices, and that the notions drawn from the anatomy were correct"— *Nervous System*, 1830. Pref., p. vii, &c.

10. In these experiments a distinction is not made between *excited* and *voluntary* motion. It was proved that the *anterior* roots of the spinal nerves were endowed with a power of *exciting* motion. It still remained to be ascertained whether they were *also* conductors of volition. This was accomplished by Professor Müller, whose results have been confirmed by Sig. Panizzi.

11. Professor Müller observes:—"If we divide in the same frog all the three posterior roots on the left side, and on the right side all the three anterior roots of the nerves of the inferior extremities, sensation in the left leg, and motion in the right leg are destroyed. If we then cut off the foot from the right leg, which retains sensation, but not motion, the frog manifests, by motion in all parts of its body, the utmost pain, but the right leg, which is the seat of the pain, is immoveable. If, on the contrary, we cut off the foot from the left leg, which retains the power of motion, but no sensation, there is total insensibility. This experiment is the most surprising of all, and affords decided, not uncertain, results; because, in the frog, we may cut wholly through the roots of the inferior extremities, the roots being very few but thick.

12. "These experiments place beyond all doubt the truth of Bell's doctrine."— *Handbuch*, p. 629.

13. Thus, then, the proof of the doctrine of Sir Charles Bell, the *second* discovery in physiology, according to Professor Müller, is complete.

14. With the posterior and anterior roots of the trifacial and spinal nerves, Sir Charles Bell associates the posterior and anterior columns of the spinal marrow, as being sentient and voluntary respectively. This doctrine wants the full proof afforded to that of the distinct functions of the two roots of the nerves by the experiments of Professor Müller.

15. The abdominal nervous columns in the *articulata* have been generally regarded as analogous with what has been designated the cerebro-spinal axis of vertebrated animals. Lyonet and Treviranus had partially traced the *third*, or more central and aganglionic column, passing *over* the ganglia of the two peripheral columns; but to Professor Müller is due the merit of having first *traced* and *figured* the third column passing over the upper surface of the ganglia (in the scorpion) in the entire length of the nervous system; and to Professor Grant that of having first distinctly assigned (in his lectures in 1832) to this column its special *motor* function.

16. This latter fact has been certified to me by a pupil who attended Professor Grant's lectures in that year, and who favoured me with a copy of his notes. The doctrine has been very awkwardly, very ungraciously, and very ungratefully published by another pupil, without acknowledgment of the source from whence it was derived. The matter is of the more consequence because that which Professor Grant deduced from analogy and reasoning, has been confirmed by experiment.

I took a lobster and laid bare the nervous columns.

17. I first stimulated one of the aganglionic nerves. The muscles to which it was distributed, and *they alone*, were contracted.

18. I then stimulated a ganglionic nerve. Muscles, both *anterior* and *posterior* to the part stimulated, were excited into combined action.

19. The same event occurred when I stimulated a part of the general or combined nervous column itself.

20. I have thus detailed to you, in as plain terms as possible, the present state of our knowledge of the *cerebral* division of the nervous system. It comprehends,

21. I. Sentient nerves, leading to the posterior roots of the trifacial and spinal nerves, and the posterior columns of the spinal marrow.

II. The cerebrum, the centre of the system.

III. The voluntary nerves issuing from the anterior columns of the spinal marrow and the anterior roots of the trifacial and spinal nerves.

22. A sketch of the cerebral system is given in the subjoined plate.

23. The *lines* which are bracketted with the sketch of the system, are intended to denote the course and ultimate destination of these two sets of nerves, and will be found especially interesting when contrasted with similar lines denoting the operation of another principle,—another system, to which I now proceed to direct your attention.

II. Of the True Spinal, or Excito-motory System.

24. The principle of action to which I allude has long been partially known to experimentors, but it has not hitherto had a place in physiology, or been applied to explain the phenomena of life, of health, or of disease.

25. It was designated the vis nervosa by Haller; it has been called the *motorische kraft*, or *vis motoria*, by Professor Müller, and "excitabilité" by M. Flourens.

26. It has been ascertained that this principle exists in the tubercula quadrigemina, the spinal marrow, and the motor nerves, to the exclusion of the brain and the nerves of sense, the olfactory, the optic, the acoustic; and in the anterior, to the exclusion of the posterior roots of the spinal nerves.

27. It has been supposed by all physiologists that this principle acts *only* in the direction of the branches or fibres of nerves, proceeding *from* their source in the nervous centres *to* their destination in the muscular system. Haller observes, "If a nerve be irritated contraction occurs in the muscle to which that nerve is distributed. If a nerve which is distributed to many muscles, or to a whole limb, be irritated, all those muscles are excited into contraction. Lastly, if the medulla spinalis be irritated, all the limbs are convulsed, which receive nerves from *below* the part irritated, but not the limbs which are situated *above* that part." Haller concludes, "That condition of the nerves which excites motion in muscles proceeds *from above*, or *from* the cerebrum, or medulla spinalis, *downwards*, towards the termination of the nerves." He adds, "So that it appears that the cause of motion acts in the direction *from* the trunk *to* the branches, but not in that *from* the branches *to* the trunk."

28. Professor Müller treats this subject still more at length, and has laid down the following laws in regard to the mode of action of the motor power:—

29. "1. The motor power acts *only* in the direction of the primitive nervous fibres going to muscles, or in the direction of the branches of the nerves, and *never backwards*.

30. "2. The mechanical or galvanic irritation of a part of a nervous trunk does not excite the motor power of the whole nerve, but only of the isolated part.

31. "3. A spinal nerve, which passes into a plexus, and assists, with other spinal nerves, in the formation of a large nervous trunk, does not impart its motor power to the whole of that trunk, but only to the fibres which it affords in its course from that trunk to the branches.

32. "4. All nervous fibres act in an isolated manner from the trunk of a nerve to its ultimate branches."—*Handbuch*, I., 656.

33. Thus, if a muscular nerve, or nervous plexus, be stimulated, either mechanically by

the forceps, or by means of the galvanic influence passed across its fibres, the muscle or muscles to which it is distributed are excited into contraction. This fact is represented in the subjoined figure.

34. The same phenomenon is observed, if, instead of stimulating a muscular nerve, the spinal marrow itself be subjected to the action of a mechanical or the galvanic stimulus. All the limbs, the muscles of which receive nerves from *below* the part of the spinal marrow which is subjected to the influence of the stimulus, are thrown into action. This fact is represented in the subjoined woodcut.

35. These are amongst the oldest of physiological experiments. Nevertheless, they are totally without application to physiology. It was surely improbable that a principle of action should exist, so distinct, so energetic, without playing its part in the phenomena of life. You will not, therefore, be surprised to learn that it has, indeed, a wide and extensive influence and agency in the animal economy.

36. But before I proceed to explain to you this extended application of the vis nervosa to physiological phenomena, I must call your attention to another series of experimental facts, equally known to physiologists, yet equally without application to physiology. We are indebted for our knowledge of these facts principally to Redi and Whytt, to Sir Gilbert Blane, to Legallois, and to Mr. Mayo. I shall quote interesting but brief details from each of these authors.

37. Redi removed the head of a large tortoise. It survived thirty-three days. As often as the fore or hind feet were pricked, it moved them with force, and was convulsed.

38. Whytt observes, "A frog, after it has been deprived of its head, when touched, often jumps and moves about for a considerable time, and it is observable that, when the toes of its hind feet are any way stimulated, it draws the feet up to its body; nay, when they are in this situation, if the toes are again irritated, the legs and feet are not extended, but brought still closer to the body. If one of the legs is pulled down from the body and kept extended, no sooner are the toes of this foot wounded than the leg is drawn up to the body as before."—*Works*, 4to., p. 303.

39. Sir Gilbert Blane states, "I took a kitten, a few days old, and divided the spinal marrow, by cutting it across at the neck. The hind paws being then irritated by pricking them, and by touching them with a hot wire, the muscles belonging to the posterior extremities were thrown into contraction, so as to produce the motion of shrinking from the injury. The same effects were observed in another kitten, after the head was entirely separated from the body. In repeating this experiment, I found that when the spinal marrow was cut through between the *lumbar vertebræ* and *os sacrum*, the *posterior extremities* lost their irritability, but the part below it, the tail, retained it." "In an acephalous monster the like *phenomena* were observable. It moved up its knees when the soles of the feet were tickled, it performed the act of suction, passed urine and fæces, and swallowed food."—*Select Dissertations*, p. 262.

40. Legallois states, "In a decapitated frog it is only necessary to touch the skin to excite movements of the limbs;" and he adds, "if we make transverse sections of the spinal marrow, the parts corresponding to each *segment* retain sensation and voluntary motion, but without any harmony, and in a manner as independent as if the whole animal had been divided at the same places."

41. Mr. Mayo has repeated the experiment of Legallois. That gentleman observes, "I have varied this experiment by dividing the spinal chord at once in the neck, and in the back, upon which three unconnected nervous centres exist, and the division of the skin in either part (and especially at the soles of the feet in the two hinder portions), produces a convulsive action of the muscles in that part.—*Mayo on the Roots of the Nerves*, p. 20. Mr. Mayo makes remarks similar to those of Legallois in reference to the distinction of different segments of the spinal marrow.

42. Of all the physiologists who have treated of this matter, Sir Gilbert Blane alone perceived that the movements which have been described were different from those produced by sensation and volition. Neither he, nor any other philosopher has, however, formed the slightest conjecture *what* the principle of action in these movements *really is*. *No one* has imagined what I now proceed to demonstrate, that they, in reality, depend upon the vis nervosa of Haller, acting in directions, however, at variance with the opinions which he had formed, and the laws which Professor Müller has proposed relative to the mode and direction of action of that motor power.

43. In the preceding brief account, I have endeavoured to give a just idea of the state of the science when I began my investigations several years ago. It consisted of mere experiments—mere facts, untraced to any just principle of action, unapplied to the phenomena of life. These experiments could possess little intrinsic value. They assume a very different rank and importance now that I have been able to demonstrate their dependence on the one and identical principle of the vis nervosa, and their extensive application to physiology and pathology.

44. Not a step could be taken in this course until the opinion of Haller, and the laws of Professor Müller, relative to the vis nervosa, or motoria, were confuted.

45. No second step could be taken until it was shown that the power which was only known to act upon external and cutaneous surfaces, in experiments, acts also upon *mucous internal* surfaces in the living animal economy.

46. These two objects I have accomplished in a series of experiments which I now proceed to detail.

47. 1.—The head of a turtle being removed, to remove sensation and volition, I denuded and divided the spinal marrow in the dorsal region; I then irritated the *lower* end of the *upper* portion by a needle, the forceps, and galvanism; I produced movements in the *superior* extremities. The motor power had acted in a retrograde direction. This experiment is represented in the subjoined figure:—

48. 2.—In another decapitated turtle, I laid bare the spinal marrow in the dorsal region, and stimulated it as before. I produced motions in *both* the superior and the inferior fins. This experiment, represented in the subjoined sketch, combined the experiment of Haller and my own, and proves that it is the *same* motor power which acts in *both*.

49. 3.—Instead of denuding the spinal marrow, I now exposed a spinal intercostal nerve in the decapitated turtle, and stimulated it as I had done the spinal marrow itself in the former experiment. I produced similar movements in both the superior and inferior extremities. In this experiment the motor power again acted in a retrograde, or in an *incident* course, into the spinal marrow, and both upwards and downwards into both extremities. This experiment is portrayed in the subjoined woodcut:—

50. 4.—In the next place, instead of irritating the spinal marrow, or the nerves, I irritated the *cutaneous* surface to which those nerves are distributed, in a decapitated turtle. Precisely the same phenomena ensued; both superior and inferior extremities moved. The same effects were observed when I irritated the extremities of any of the fins. But this is identical with the experiments which we have quoted from Whytt, Legallois, &c., and referred by them and by all physiologists, with one exception,

to sensation. It is sketched in the following woodcut :—

51. I have thus traced the operation of the vis nervosa of Haller, in new directions, until I have shown that its last mode of action is *identical* with that of the second series of experiments to which I have alluded. It now remains to point out the *application* of this principle to the phenomena of the animal economy.

52. Now, on irritating the border of the glottis in an animal from which the brain has been removed, the larynx is closed; on irritating the border of the anus, the sphincter is firmly contracted. By an extended series of experiments I have proved that these, and a multitude of other physiological phenomena, to be detailed hereafter, depend upon the action of the spinal marrow; and thus, I think, my demonstration is complete. It is given in the annexed woodcut; for it is most important as denoting the progress of this inquiry :—

53. This sketch plainly shows the progress of this inquiry. The action of the larynx and sphincter ani are shown in the most distinct manner to depend upon the vis nervosa of Haller. The statement must be generalised so as to include *all* the *orifices* and *all* the *sphincters* of the animal frame.

54. But there are further applications of the excito-motory power to physiology.

55. These remarks lead me to observe that *all* the acts of this system are the result of *excitation*, by stimuli applied to *nerves* which proceed to the *spinal marrow*, whence other nerves take their origin, and pursue a *reflex* course to the parts to be moved.

56. The *system* of *incident nerves*, of the *true spinal marrow*, and of *reflex nerves*, is, like the agency carried on through it, new to physiology. It presides with its own power over the acts of ingestion and expulsion in the animal economy,—over the orifices and sphincters of the animal frame. It is represented in the subjoined plate :—

57. The lines bracketted with the figure denote the varied course in which the excito-motory power moves and acts, and effectually disproves the idea of mere *segments* of the spinal marrow. If that idea were true, we must, at least, admit of segments in longitudinal as well as transverse directions.

58. The subjoined figures represent the course of incident nerves—as the trifacial,

the spinal centre, and the course of reflex nerves—as the facial, through which the excito-motory property acts, in the excited closure of the eyelids on touching their borders or lashes in the case of apoplexy :—

59. *Five* circumstances are required in this and every instance of an excito-motory act :—1, *an excitant;* 2, *an excitor nerve* continuous to the nervous centre ; 3, the integrity of *that centre* ; 4, a *motor nerve* continuous to the muscle to be excited into contraction; and, 5, that *muscle* endowed with perfect irritability.

60. If *any* part of this arc be interrupted, the phenomenon ceases instantly. The subjoined figures represent the spinal centre—the key-stone of the arc, as it were, destroyed :—

61. The first of *these* subjoined figures represents the experiment in which the *incident* nerve alone, the second that in which the *reflex* nerve alone, and the third that in which *both* are severed :—

62. These facts prove that certain incident nerves, as well as the spinal marrow and motor nerves, are excito-motory ; and they establish a *class* of such nerves previously unknown to physiologists, or confounded with sentient nerves.

63. The two next figures represent an incident nerve, as the trifacial, or the nerve which supplies the border of the larynx, or of the sphincter ani, proceeding to the upper or lower portion of the spinal marrow ; and a reflex nerve, as the facial, the pneumogastric, or the nerve of the sphincter ani, proceeding from that organ to and from points which are nearly on the same parallel. They may be said to denote distinct *segments* of the spinal marrow.

61. But of the subjoined figures the one placed on the left denotes the *direct*,—

the one in the opposite column the *retrograde*,—course of the excito-motory influence along the spinal marrow, as observed in experiments in physiology, and in the effects of diseases and of remedies, and disprove the idea of the excito-motory phenomena being restricted to *segments* of the spinal marrow, at least *transvĕrse* segments; and prove the existence, at least, of segments taken in a longitudinal direction.

65. From the experiments which have been detailed, we may, I believe, infer the existence—

66. 1.—Of a *true spinal marrow, physiologically* distinct from the chord of intra-spinal nerves.

67. 2.—Of a *system of excito-motory nerves, physiologically* distinct from that of the sentient and voluntary nerves.

68. 3.—Of a nervous influence—the excito-motory power—operating in directions *incident*, *upwards*, *downwards*, and *reflex*, with regard to the true spinal marrow, the centre of this excito-motory system.

69. The entire medulla spinalis in the *vertebrata* consists, then, of *two* portions, so intimately blended together, indeed, as not to be easily separated by the anatomist, and, perhaps, only to be distinguished by

physiological experiments and pathological observations. The *first* of these is the intra-vertebral *chord* of sentient and voluntary *nerves*, which proceed *to* and *from* the *cerebrum* as their centre. It is represented in the figure § 22. The *second*, which may be denominated the true spinal medulla, is distinguished by being *excito-motory*, and is the axis of a peculiar system of excitor and motor, or excito-motory nerves, generally, but perhaps not invariably, blended with the former. This is represented in the sketch given § 57.

70. The close combination of these two portions of the nervous system, in the *vertebrata*, is the consequence of the necessity for the several pairs of compound nerves being *inter-vertebral* in their exit from the spinal canal. In the *articulata* this necessity does not exist, and the two systems may, therefore, be anatomically, as well as physiologically, distinct. Indeed, I think I have ascertained that, whilst the ganglionic nerves in the lobster are incident and excitor, and the columns both direct and retrograde in their influence, the aganglionic nerves are purely motor (as Professor Grant

first conjectured), and direct in their mode of nction.

71. These observations lcad naturally to the question,—Is there, in any class of animals, a distinct *anatomy* of the excito-motory power? Are there excitor nerves distinct from nerves of sensation? Are there motor nerves distiuct from ncrves of volition?

72. In the first place, I may observe that the olfaetory, optic, and aconstic nerves are nerves of *sense* only, and destitute of excito-motory powcr; so are the cerebrum and eerebellum, the former of which is probably the centre of the senticnt and voluntary system. Is there a pure *voluntary* nerve? a nerve which conveys the acts of the will withont possessing the motor, or excito-motory power? It appears to me, that *one* such purely voluntary nerve only exists, for every muscle of the animal power, with one exception, seems to requirc *tone*, which is a result of the excito-motory power, conveyed by motor nerves, probably involvcd, in general, in tbe same neurilemma with voluntary nerves. This power acts during *sleep*, in *all* muscles, *except the levator palpebræ*, and perhaps the four *recti* oculi.

73. But ns there are purely senticnt nerves, it may be a question, whether there be purely excitor nerves. Such a nerve probably does not exist absolntely in health. An experiment made by the late Mr. Broughton, Mr. Field, and myself, in 1835, led to the conclusion that the *pneumogastric* uerve is destitute of sentient property This nerve is certainly the least sentient, and the most purely excitor, of any in the class *vertebrata*. In certain cases of discase we, however, observe the sentient power annihilated, whilst thc excito-motory still continues; this occurs in those diseases of the brain which destroy the sensibility of the facc; the excito-motory property may remain, and the eyelash and the nostril be as snsceptible of stimuli as ever. In the experimeuts in which tbe cerebrum, the *centre* of the sentient nnd voluntary system, is removed, and in diseases, and in other cxperiments in which the spinal marrow is disorganised, or dividcd, the phenomena which remain are entircly of the excito-motory elass. Sentient nnd voluntary uerves are blendcd with the cxcitor and motor nerves, but their functions are snspended when the influence of the centre of their system is cnt off. The eentre of the excitor and motor ncrves being the appropriate portions of the spinal marrow itself, the fnnctions of these nerves remain.

74. Still the two sets of ncrves arc generally blended anatomically. If they be distinct in any class of animals, it is probably in the *invertebrata* (see § 70), and especially in their lowest forms, in which sensntion and volition are nearly extinct, and the animal lives a sort of excito-motory life only.

75. But if the existence of a *distinct* anatomy of the excito-motory system be doubtful, that of tbe *blended* anatomy, and that of of the distinct physiology, pathology, and therapeutics of this system, arc perfectly obvious.

76. I think I may now regard the proof as quite complete, tbat the principle formerly desiguatcd the vis nervosa, and that which operates in producing that series of actions, which have been designatcd instinctive, antomatie, sympathetic, &c., but which I propose to designate excito-motory, are one and thc same. Thc incident, retrograde, and reflected courses, and the combined forms in which it opcrates, are at vnriance with the laws of its operation, dcdueed from the facts formerly known by Professor Müller, and afford the *type* of the extensive series of physiological, pathological, and thcrnpentic phenomena to which I have alluded.

77. The cxperimental fnct noticcd and represcnted § 50, gives the type of all those physiological phenomena in which the excito-motory property nets, first in an ineident, and then in retrograde nnd reflex dircctions, and in *combined* modes, as we observe in the cxeited acts of ingestion and expulsion, and in the action of the orifices and sphincters.

79. The same fact represents the effccts of dentition. The experiment dctailed and represented § 49, affords us the type of traumatic tetanus.

80. The therapeutics of agents which operate through tbe excito-motory system, are still nearly unknowu, and require a careful investigation. Strychnine, besides acting on the general excito-motory system, is apt to affect the larynx; eantharadine, the cervix vcsicæ, &c.

81. In *all* these actions the medulla oblongata, or the medulla spinalis, is the special COMBINER and DISPOSER of the excito-motory influence, in producing those complex effccts and operations which we observe in deglutition, respiration, &c.

82. This brief view of the excito-motory system appears to me to consist in a series of expcriments and observations, rather than of deductions. It is, therefore, scarcely liable to error; its originality is obvious; its importance will be made manifest as we proceed.

83. We are now prepared to trace the excito-motory power, for so I have designated the principle of action variously termed the *vis nervosa*, the *vis motoria*, tbe *excitabilité*, in

I. *A special anatomy;*
II. *A special physiology;*
III. *A special pathology;* and
IV. *Special therapeutics.*

These subjeets will be discussed in my uext and subsequent lectures, previously to which I must make a few remarks upon the *ganglionic* division of the nervous system.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, February 10, 1838.]

LECTURE II.

THE GANGLIONIC SYSTEM.—*Its cerebral portion. The internal ganglionic system.—Real office of the trigeminal and spinal ganglia. Effects of lesion of the fifth nerve. Detail of experiments.* PHYSIOLOGY OF THE NERVOUS SYSTEM.—*The senses. Functions of the brain; of the true spinal system. Approximation to the true theory by M.M. Magendie and Mayo.*

GENTLEMEN:—In my last lecture I *proved* to you that the vis nervosa of Haller, and the principles of the motions observed in certain experiments of Redi, Whytt, Blane, Legallois, &c., are *one and the same*; and I *demonstrated* that this principle, hitherto without *application* to science, has a most extensive domain in physiology and pathology.

85. I shall now proceed to treat of these subjects more particularly; but I must first notice, very briefly, another subdivision of the nervous system—the *Ganglionic*.

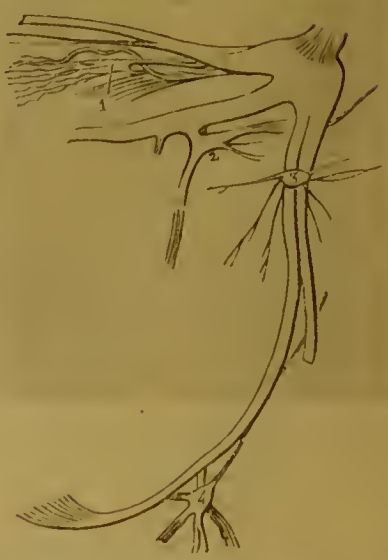
III. THE GANGLIONIC SYSTEM.

The ganglionic system consists of two parts.

86. The first of these is that situated amidst the organs of the face and head; it is chiefly connected with the *trifacial* nerve, and it comprehends *four* distinct ganglia, viz.:—

1. *The ophthalmic*, or *ciliary*.
2. *The rhinic*, or *nasal*.
3. *The otic*, or *auricular*.
4. *The glottic*, or *lingual*

I subjoin a sketch of this part of the ganglionic system, and I beg your attention to its various connections, not only with the trifacial, but with the nerves of the organs situated in the face, and with that part of the ganglionic system which I proceed to notice,



the *internal ganglionic*, or that designated the *grand sympathetic*, from an erroneous notion that upon it depended the extensive series of sympathetic actions which I have shown to be functions of the true spinal or excito-motory system; for, according to Professor Müller, "it explained everything and yet nothing."

87. The internal ganglionic system extends from the head to the pelvis. It consists of a series of ganglia and plexuses, connected together,—with each root of the successive pairs of spinal nerves,—and with all the viscera of the thorax and abdomen, by means of slender nerves. Of this portion of the ganglionic system a sketch is subjoined in next page.

88. But there are other ganglia besides those of the head and neck, and of the large cavities,—those formed upon the major portion of the trifacial, and upon the posterior

roots of the spinal nerves, and there is an interesting question, What is the office of *these* ganglia?

89. I *think* there is much reason for considering these ganglia as a part of the general ganglionic system, as constituting an *external* ganglionic system, for the formation and nutrition of the external limbs, and for certain secretions, as that of the lachrymal, the parotid glands, &c.

90. I would, therefore, propose to divide the ganglionic subdivision of the nervous system into—

I. *The external*, comprising,
  1. *The fifth;*
  2. *The posterior spinal.*
II. *The internal*, comprising,
  1. *The sympathetic;*
  2. *The pneumogastric?*

91. The argument may be stated thus:—1. There is an internal nerve for formation, nutrition, secretion, &c. 2. This nerve is ganglionic. 3. There are external organs and structures requiring nutrition, &c. 4. There are also external ganglionic nerves. The inference is plain, that these constitute the external ganglionic sub-system.

92. The ganglia upon the nerves were first observed to be attached to the portio major of the fifth and the posterior spinal nerves, not, as Sir Charles Bell states, by Monro, but by Prochaska. This latter author observes, in the preface to a republication of his work in 1800:—"This treatise, which appeared in 1799, contains several new observations upon the nervous system." "Amongst these is the fasciculus of fibres of the fifth pair of the cerebral nerves, which *passes* the semilunar ganglion and *joins* the third, or inferior, maxillary branch of that nerve.

93. "Amongst these, too, are the anterior roots of all the spinal nerves, which, in like manner, *pass* the ganglia of the posterior roots of those nerves."

"On this subject many excellent works have appeared since the publication of my treatise, especially 'Observations on the Structure and Functions of the Nervous System,' by Monro (in 1783); 'Ueber das Organ der Seele,' by Soemmering, Königsberg, (in 1796); and 'Reilii Exercitationes Anatomicæ de Structura Nervorum'" (in 1797)."

94. I am not aware that any preceding inquirer has suggested the real office of the ganglia on the fifth and posterior spinal nerves. Prochaska asks (p. 353), "Who will assign the reason why the interior roots of the spinal nerves pass the ganglia, whilst the posterior roots join them? Why, of all the cerebral nerves, the fifth pair alone, after its origin, forms, in the manner of the spinal nerves, the semilunar ganglion, under which

the peculiar fasciculus of fibres passes, still in the manner of the spinal nerves, proceeding to *join* the third or inferior maxillary branch?"

95. It is true that the semilunar and external spinal ganglia differ in appearance from the ganglia of the sympathetic, as Sir Charles Bell has well displayed. What is the nature of this difference? To this question I find no reply in authors. It is plain, however, that the difference consists in their being, alone, *plexic*. The internal ganglionic nerve is purely nutrient; its ganglia are simple. The external involve sentient, and, I believe, excitory nerves, with the nutrient; they combine, therefore, the appearances of the plexus and of the ganglion.

96. But are there any other anatomical facts, any physiological and pathological facts, which lead us to think that the trifacial and spinal nerves, besides their other functions, possess a nutrient and secretory power? Indubitably there are.

97. 1.—The distribution of this nerve to the lachrymal, parotid, and submaxillary glands, can only be for secretion. I refer you, upon this point, to the beautiful Dissertation of Sig. Bellingeri.

98. 2.—The experiments of M. Magendie, in which division of the trifacial within the skull led to the destruction of the eye, can only be explained in this manner.

99. 3.—The cases of destruction or compression of the trifacial within the cranium, from disease of the human subject, are of the same character. Such a case is amply detailed by M. Serres. Such cases have occurred to Dr. Alison and Mr. Stanley, and these I shall quote at length.

100. "A remarkable circumstance connected with the affections of the fifth nerve, is the tendency to inflammation and sloughing in parts which have lost their sensibility, particularly in the eye. A very instructive case of this kind occurred to my friend Dr. Alison. The patient had loss of common sensation on the left side of the face, the left nostril, and left side of the tongue, with insensibility of the ball of the eye, and occasional bloody discharge from the left nostril, and was liable to attacks of pain occasionally accompanied with fever, during which the pain was chiefly referred to the insensible parts. There were frequently attacks of inflammation of the left eye, with dimness of the cornea, which were relieved, from time to time, by the usual antiphlogistic means; but at the end of two months, a line formed round the base of the cornea, which at length sloughed out, and the contents of the eye were entirely discharged. The muscles of the left side of the jaw were paralytic, and felt quite flaccid when the patient chewed or clenched the jaws, but the motion of the muscles of the cheek was unimpaired. After the destruction of the eye, the paralytic symptoms remained stationary for a year or more; there was then a violent return of headach with fever, and death, in a state of coma, after an illness of a fortnight. On inspection, there was found considerable ramollissement of some of the central parts of the brain. The fifth nerve of the left side, on being traced backwards from the ganglion, was found, close to the ganglion, to be of a very dense texture, but beyond this it was much wasted, and, at its junction with the tuber annulare, nothing but membrane seemed to remain. In another case of Dr. Alison's, there was loss of sensation of the left side of the face, followed by inflammation and sloughing of the eyeball; after which the sensibility of the parts returned. The patient was, before the appearance of these symptoms, and has since continued, liable to severe headach and epileptic fits. The loss of sensibility continued about six months.

101. "A remarkable combination of symptoms occurred in a case related by Mr. Stanley. There was hemiplegia of the left side, without loss of sensation in the arm and leg, but in the left side of the face both sensation and motion were entirely lost. In the left side of the tongue sensation was lost, but motion remained. The mucous membrane of the left nostril was always of a deep red colour, and there were frequent discharges of blood from it. The conjunctiva of the left eye became deeply injected; this was followed by opacity and ulceration of the cornea, and at last by total disorganisation of the eye. There was total loss of hearing in the left ear. There were frequent attacks of erysipelas, which were entirely confined to the paralytic parts of the face. The patient had been long affected with headach, and, at last, died two months after the commencement of the paralytic symptoms. A tumour was formed in the left side of the tuber annulare, which compressed the origin of the fifth and seventh nerves against the base of the skull. The tumour was the size of a walnut, and extended into the left crus cerebelli."—(*Abercrombie on the Brain*, 3rd ed., p. 424, &c.)

102. In a word, if the sensation of the face be lost by paralysis, arising from disease of the *brain*, the eye is safe; but if the same event occur from compression or destruction of the *fifth*, *within* the cranium, by disease, or in an experiment, the eye ceases to be nourished, and becomes destroyed. In the former case the nerve of sensation merely has suffered; in the latter the nerve of nutrition, as well as sensation, has been involved in the disease or injury.

103. 4.—I must draw your attention particularly to a branch of the trifacial nerve discovered by M. Arnold, and termed by him

the *recurrent* of the fifth. It is represented below :—

It returns from the ophthalmic branch of this nerve to be distributed between the laminæ of the tentorium. What can its function be, in this situation? It cannot be *touched*. It cannot, then, be for *sensibility*. It cannot be for *excited* motion. It can only be formation, for nutrition. Such, then, is the *probable* function of this nerve.

104. A series of experiments alone could determine whether the destruction of the ganglia on the posterior roots of the spinal nerves, would influence the nutrition of individual parts or limbs. Some of the cases of defective growth, development, and nutrition, in infants may depend upon disease, situated so as to interfere with the texture or function of these ganglia. Observation must elucidate this point.

105. 5.—The whole nervous system seems to have a certain influence over the action of the heart. According to the experiments of Legallois, and Dr. Wilson Philip, to *crush* the brain, or the spinal marrow, enfeebles or arrests the circulation. I have discovered that the same effect is produced by crushing the limbs, and this is doubtless effected through the medium of the ganglionic system.

106. A frog was made perfectly insensible by the application of laudanum or alcohol. Its respiration ceased. It did not move on the application of any irritant. The circulation in the web was carefully observed. When it had long continued in the same enfeebled state without change, the thigh was crushed. The circulation in the minute and capillary vessels ceased at once, and never returned. The stomach was now crushed in the same manner. The heart ceased to beat for many seconds; its beat then returned, but never regained its former force. The effect was precisely such as was observed by Legallois on crushing the spinal marrow. There was not the least indication of pain in either experiment.

107. The experiment was repeated. The result was so perfectly similar, that a note was written at the time, stating that the experiment need not be again repeated.

108. Nevertheless, it was repeated several weeks afterwards, with precisely the same results. The action of the spirit upon the cutaneous surface had arrested the respiration, destroyed all sensation, and induced considerable languor in the circulation in the web. When this state had continued uniform during a considerable time, the other limb was crushed by a hammer. There was not the slightest motion of the animal or expression of pain, so deep was the insensibility. The circulation in the whole web ceased instantly.

109. The spinal marrow being removed in an eel, the circulation became, at length, much enfeebled in the pectoral fin. The part one inch and a half below the heart was crushed; the circulation in the pectoral fin now ceased suddenly and entirely.

110. In an eel, in which the brain had been carefully removed, and the spinal marrow destroyed, the stomach was violently crushed with a hammer. The heart, which previously beat vigorously sixty times in a minute, stopped suddenly, and remained motionless for many seconds. It then contracted; after a long interval it contracted again, and slowly and gradually recovered an action of considerable frequency and vigour. No experiment can more clearly demonstrate the effect of violence inflicted upon the system generally. The experiment is the more remarkable because the connection and influence of the brain and spinal marrow were entirely removed. The organic structures must have been the medium through which the effect of the violence was conveyed to the heart.

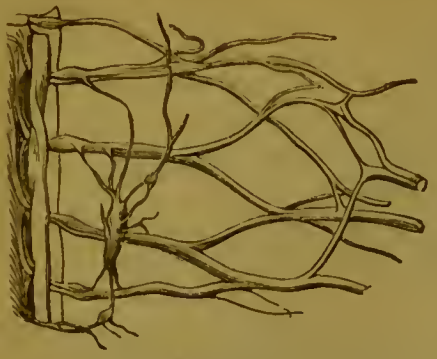
111. Similar events have occurred in surgical practice. A robust and healthy waggoner fell down, and the wheel of his heavy waggon passed over the abdomen. The beat of the heart was so enfeebled that the pulse could scarcely be felt. No reaction took place. The effect was perfectly similar to that of crushing a portion of the brain and spinal marrow. On examination the ileum was found lacerated in two places.

112. A man had his arm drawn in, and violently crushed, and torn off, by some machinery. The action of the heart failed, and never rallied.

113. Every one will remember the melancholy accident which occurred to the late Mr. Huskisson. The tremendous vehicle passed over the thigh. The action of the heart failed, and the surgeon waited for reaction—for an opportunity for amputation—in vain.

114. I will conclude these remarks by the following sketch, which shows the distinct

union of the *external* and *internal* ganglionic systems.



115. I must now resume the subjects of the first part of these lectures already enumerated § 83, viz.:—

1. *The anatomy;*
2. *The physiology;*
3. *The pathology;*
4. *The therapeutics, of the true spinal or excito-motory system;*

interposing, occasionally, observations upon the cerebral system.

116. It will prevent repetition if I begin with the *second* of these subjects, or the *physiology*, and then treat of the *first*, or the *anatomy*; for it is by physiological phenomena principally, if not entirely, that the anatomy has hitherto been pointed out. It is impossible through the medium of the irritation of *certain* portions of the nervous masses, to excite muscular contractions. It is impossible to apply the slightest stimulus to *other* portions of the nervous structures without inducing muscular contractions, directly or in a reflex manner. The former parts of the system *do not* belong to the excito-motory system; the latter *do*. Experiment has taken the place of the scalpel. It has traced the anatomy of the different portions of the nervous system. Whether the scalpel will ever be able to confirm the anatomical results from experiment, remains to be discovered.

I now proceed to treat of

I. The Physiology of the Nervous System.

117. In order to convey a distinct idea of my views of the nervous system at once, I shall begin by the detail of one experiment, and the performance of another.

118. A horse was struck with the poleaxe over the anterior lobes of the brain. It fell instantly, as if struck with a thunder-bolt; it was convulsed, and then remained motionless. It shortly began to breathe, and continued to breathe freely by the diaphragm.

119. When lacerated or pricked by a sharp or pointed instrument, as a *pin* or a *nail*, on any part of the face or surface of the body, it was totally motionless manifesting no evidence of sensation or volition.

120. When, on the other hand, the *eyelash* was touched with a *straw*, the eyelid was forcibly closed by the action of the *orbicularis*. When the cornea was touched, the eyeball revolved outwards by the action of the *abducens*. When the verge of the anus was touched, the *sphincter* contracted forcibly, the tail was raised, the vulva was drawn towards the anus.

121. The upper part of the medulla oblongata was now destroyed by an instrument passed through the orifice made by the poleaxe: there were violent convulsions; the respiration ceased, and the eyelid and eyeball remained motionless on the application of stimuli.

122. Now, I imagine that it will not be disputed, that the blow of the poleaxe, in this case, annihilated the cerebral or sentient and voluntary functions; and that a peculiar set of excito-motory phenomena remained. Deep lacerations produced no evidence of the former; the touch of a straw induced full manifestations of the latter. The destruction of the medulla oblongata removed all trace of excito-motory phenomena in the eyelid and eyeball.

123. You observe this living frog; its sentient and voluntary functions are obvious. I divide the spinal marrow, below the occiput, with these scissars: all is still. There is not a trace of *spontaneous* motion. The animal would remain in this very form and position, without change, until *all* signs of vitality were extinct. But now I pinch a toe with the forceps. You see how both posterior extremities are moved. All is now still again; there is no spontaneous motion, no *sign of pain* from the wound made in the neck. It is without sensibility—without volition; the *power* to move remains—the *will* is extinct. I now pinch the integument. You observe the result—the immediate recurrence of excito-motory phenomena.

124. I now destroy the whole spinal marrow with this probe. It is in vain that I pinch the toes; the animal, the limbs, are motionless!

125. Could the former *excited* motions be those of irritability? I will try the truth of this suggestion by seeing whether, now that the axis of the excito-motory system is destroyed, with its phenomena, the application of a slight galvanic shock will prove the subsistence of irritability. You see how instantaneously and forcibly the muscles are stimulated to contraction.

126. Is not the proof, from these experiments, of distinction between the motions of volition, of the excito-motory system, and of these from those of irritability, perfectly and unequivocally complete?

127. Similar phenomena are observed in the human subject. In a patient in deep coma, I pierced the skin on the cheek, the hand, the thigh, &c., with a pin; there was no manifestation of sensation—no motion

whatever. I then touched the eyelash and the *internal* nostril, with a feather; this induced action of the orbicularis and levator alæ nasi. I then pricked the exterior part of the nostril with the pin; the action of the levators was immediate. The respiration was almost entirely diaphragmatic. There was effusion in the ventricles; no other morbid appearances.

128. In these cases we had the *cerebral* functions annihilated,—the *true spinal*, or *excito-motory*, entire.

129. But I must now proceed more systematically with my lecture.

130. I shall not detain you long with the physiology of the cerebral subdivision of the nervous system: it embraces sensation, perception, judgment, volition, and voluntary motion.

131. The senses are, the smell, the sight, the hearing, the taste, and the touch; they convey to the mind all we know of the external world. Perception is derived from them. Volition is a subsequent mental act, and voluntary motion a frequent result; and thus the motions which result from sensation always *imply volition*; but as volition may exist without any previous sensation, the voluntary motions are frequently *spontaneous*. It is by this character that the motions which belong to the sentient and voluntary system are distinguished from those which belong to the excito-motory; these are never spontaneous, they are *always excited*. Even the motions of respiration, as far as they belong to this system, are excited motions, as I shall show immediately. Legallois, M. Flourens, and Sir Charles Bell, are equally in error, I think, when they consider the medulla oblongata as the *source*, the *primum mobile*, of the respiratory motions; it is the *channel* through which the excitors act, and the organ which *combines* the different movements which constitute the acts of respirntion; but the true *source* of these movements are certain excitor nerves,—the excitors of respiration,—and principally branches of the pneumogastric, but also of the fifth and spinal nerves. Equally remote from the truth, I think, is the opinion of Dr. Philip and Mayo, that the acts of the respiration are entirely voluntary. This is, in fact, a mixed function, as *all* the acts of the excito-motory system may be, and although generally belonging to the excito-motory system, yet capable of being effected through the medium of volition. This subject will be pursued hereafter.

132. A point which belongs more immediately to our present subject,—the cerebral system,—is that of the influence of the senses over the acts of volition. There is a case of nnæthesia, published by Dr. Yelloly, in the "Transactions of the Medico-Chirurgical Society," vol. iii. p. 99. The patient could hold a cup in her hand securely, if she kept her eyes fixed upon it; but if she ceased to look at it, it fell to the ground. I have this day seen a patient with a slight degree of paralysis of feeling and of voluntary motion in his lower limbs. He walks securely whilst his eyes are fixed upon the ground, but stumbles immediately if he attempts to walk in the dark. His own words are, "My feet are numb; I cannot tell in the dark where they are; and I cannot poise myself." The voluntary motions are regulated by the sense of touch, when this is unimpaired, or by that of sight, when the touch is paralysed.

133. Many attempts have been made to *localise* the functions of the cerebrum; that is, to prove certain functions to be attached to certain parts of that organ, without, however, much success. The facts supplied by pathology certainly lead us to the conclusion that the hemispheres of the cerebrum and cerebellum regulate the *voluntary* movements of the *opposite* side of the body, whilst the medulla oblongata and spinalis *convey* these acts of *volition* to the *corresponding* side. It has been asserted from similar facts, that the anterior lobes of the brain govern the speech; the corpora striata, the inferior extremities; and the thalami, the superior extremities; but I fear these deductions are not sufficiently substantiated. The same remark must be made relative to the supposed connection between the cortical portion of the cerebrum and the intellectual faculties, and the medullary portion and the movements. I shall revert to these opinions immediately.

134. The functions of the cerebral system are, then, sensation, perception, judgment, volition, and voluntary motion. The sensations are conveyed to the cerebrum by the sentient nerves,—the olfactory, the optic, the acoustic, the glosso-pharyngeal (?), and the trifacial and posterior spinal; the cerebrum itself may be viewed as the organ of mind, that organ on which the ψυχη sits, as it were, enthroned; the voluntary nerves convey the mandates of the volition to the muscles which are to be called into action. All these functions are strictly *psychical*. They imply consciousness. Sensation without consciousness appears to me to be a contradiction in terms; the idea and the phraseology should be banished from physiology.

135. The cerebral system *sleeps*, sensation is dull, volition quiescent; dreams, &c. are the delirium of sleep.

136. How different from those which I have thus enumerated, are the functions which belong to the true spinal marrow. In these there is no sensation, no volition, no consciousness, nothing psychical. An impression is made upon the extremity of a nerve; this impression is conveyed, not to the cerebrum, but to some part of the medulla oblongata, or medulla spinalis, whence it is reflected upon certain muscles

destined to be excited into consentaneous action.

137. The true spinal system is independent of the cerebrum, and subsists when the cerebral lobes are removed. It guards, as it were, the orifices and exits of the body, regulating the ingesta and the egesta.

138. The cerebral system is the seat of the intellect; the true spinal marrow is, in an especial manner, the organ of the emotions and passions. It is on this part of the nervous system that the preservation of the individual and the continuation of the species depend.

139. The cerebral system connects us with the external world in everything that relates to sensation and volition, or mind; the true spinal system, in everything that relates to the appropriation of its materials, or their expulsion,—in everything that, in those respects, relates to nutrition and reproduction.

140. The true spinal marrow, as distinguished from the *chord* of cerebral, sentient, and voluntary *nerves*, with which it is inseparably blended in structure, is the centre, or axis, of a distinct system of excitor and motor nerves, hitherto unknown to physiologists.

141. This excito-motory system of nerves presides over ingestion and exclusion,—over retention and egestion, and over the orifices and sphincters of the animal frame. It is, therefore, the nervous system of respiration and deglutition, and of the retention and expulsion of the fæces and urine, and of the semen.

142. By means of this system, that "*tourbillon*" of the ingesta and egesta, so beautifully and eloquently described by Cuvier, is effected. By means of this system the animal frame is constituted a casket, guarded at the upper part, and securely closed at the lower.

143. The excito-motory, or true spinal system, is the nervous agent in all those *motions* hitherto confessedly not understood, by the fact of their being designated by the unmeaning term *sympathetic*, &c.

144. This system is, also, the source of *tone* in the whole muscular system.

145. The true spinal system is, in a peculiar sense, the seat, or nervous agent, of the appetites and passions. Through it the emotions affect, not the expression of the countenance and the respiration alone, but the pharynx, the larynx, the sphincters, the expulsors, and indeed the whole muscular system of the animal frame.

146. The true spinal system is susceptible of *modification* by volition, and, on this account, some of its functions have been denominated *mixed*. It is, also, constantly under a certain influence of the volition, as is manifest in the difference in the respiration, &c., during intense mental attention, sleep, and coma, and in ordinary circumstances.

147. The true spinal system *never sleeps*; respiration and deglutition, the action of the orifices and sphincters, are continued.

148. That a principle so extensive and important in the animal economy should not have been detected and known before, must appear extraordinary; and that such is the fact, may be demonstrated by considering the most simple and familiar examples of the functions over which this principle presides. Has it been stated in any work, ancient or modern, that the deglutition of water by the pharynx, the exclusion of carbonic acid by the larynx, the retention of the urine and fæces by the sphincters, are exclusively functions of the *spinal marrow*, and of a peculiar *system* of *excitor* and *motor* nerves, of which it is the centre, or axis? I have looked, in vain, over the works of Dr. Bostock, Dr. Alison, and of Mr. Mayo; of M. Adelon and M. Magendie; and of Rudolphi and Professor Müller, for an account, or even a hint, of such a principle as that involved in these familiar acts.

149. Nay, the idea of a system of *excitor* nerves, constantly operating in the animal economy, preserving its orifices open, its sphincters closed, and constituting the *primum mobile* of the important function of respiration, I believe to be new. The acts are so familiar to us, that we have thought them understood, when the nervous agents through which they have been *excited*, have not even been detected; yet, that this view is the true one, is proved by the most decisive experiments.

150. The nearest approximation to the detection of this system, is to be found in relation to the closure of the eyelid on touching its borders. M. Magendie observes, "The movement, designated winking, depends partly on the facial nerve, and partly on the nerve of the fifth pair. It ceases when the facial nerve is cut; it ceases, or shows itself very rarely, and only by the effect of a direct solar ray, when the nerve of the fifth pair is divided. The loss of the movement of the eyelids by the section, or paralysis of the facial nerve, is easily understood, since this nerve sends filaments to the orbicular muscle. It is much more difficult to understand how the section of the fifth pair arrests the *winking*, for this nerve, almost entirely destined for sensation, sends no branch to the muscles which move the eyelids."—*Précis de Physiologie*, t. i., p. 51. Mr. Mayo observes, "The muscle which closes the eyelids is called the orbicularis palpebrarum; it is disposed for some breadth between the skin of the eyelids in concentric fasciculi. This muscle is supplied by the fifth nerve, and by the portio dura of the seventh, and is paralysed by the division of the latter. The fifth nerve and the seventh rise together; the fifth imparts sensibility to the eye, to the eyelid, and eyelashes; and the least irritation of these

parts calls into action the orbicularis palpebrarum, which receives its stimulus through the portio dura of the seventh."—*Outlines of Physiology*, 3rd edit., p. 307. These two eminent physiologists are at variance in their anatomy, but obviously attach importance to the question of the distribution of the fifth to the orbicularis itself, so excluding the very idea of a reflex action. The former confesses the difficulty of explanation of the phenomenon; the latter attaches importance to the identity of *origin*, referring the phenomenon to some "consent" between the two nerves, an opinion controverted with perfect success by Dr. Alison and Professor Müller. (*Trans. of Med. Chir. Soc. of Edinb.*, vol. ii., p. 165, and *Outlines of Physiology*, 1833, p. 269. *Hanbuch der Physiologie*, 689.) Neither Mr. Mayo nor M. Magendie appears to see that the act involves a reflex, excito-motory agency, carried on through the medium of the true medulla, a fact which is proved by experiments in which the fifth pair of nerves, the medulla, and the seventh pair of nerves, are respectively divided. The central and connecting link between the two nerves, as between the excitor and motor nerves of the true spinal system generally, and in the acts of ingestion and egestion, of the orifices and sphincters, is overlooked.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, February 17, 1838.]

LECTURE III.

PHYSIOLOGY OF THE NERVOUS SYSTEM. — *Originality of the excito-motory doctrine. Conduct of the Council of the Royal Society. Detail of the functions of the excito-motory system. Excited closure of the eyelids. Physiology of deglutition. Action of the cardiac orifice of the stomach. Closure of the larynx, how produced. Physiology of respiration. Functions of the pneumogastric nerve. Closure of the sphincter ani. Action of the expulsors. Acts of generation. The tone of the muscular system. Seat of the passions.*

GENTLEMEN :—Before I commence the subject of the special acts of the true spinal or excito-motory system, I must very briefly advert to the point of the originality of my researches into this part of my subject. Let the hearer compare the works of Dr. Bostock, of Mr. Mayo, of Dr. Alison; of M. Magendie, and even of Prof. Müller (whose "Handbuch" may be considered as representing the physiology of the day more faithfully than any other, and is now partly translated into English by Dr. Baly), with the subsequent details, and then *let* HIM *judge*.

151. If I revert to this question more frequently than my hearers think necessary, let my excuse be, that my labours have been most unjustly opposed, that they have been opposed,—nay, even discarded, where they ought to have been welcomed. Will another generation believe that the paper which contained the views which form the basis of these lectures, was rejected by the *Royal Society*,—that, after being read, it was refused a place in the "Philophical Transactions;"—and that, when I offered to sacrifice five years of my life and professional avocations and advantages, to pursue this interesting subject with undivided attention, the Council even refused to look at my experiments, and that, as if to add *insult* to injury, they wrote upon my MS., in reference to the experiment of Redi, mentioned § 37, "*will they* (i. e. the *tortoise*), *live after they are made soup of?*"! * * * * * I have been accused of having used too strong a term in speaking of this treatment. Let the hearer substitute any other which may appear to him more *appropriate! I* wrote as I felt, and still feel as I then felt and wrote. I consider that a great injustice has been done me; and I have the conviction that this theory—let them call it "hypothesis" who please—will long survive the little jealousies and rivalries of its opponents.

152. Every possible mode has been adopted to deprive me of the credit of having eliminated this theory out of the meagre materials to be found in the works of Whytt, Legallois, Mr. Mayo, &c. Anonymous critics, and commentators not anonymous, have united for this purpose. One of the latter is Mr. Owen (see vol. iv., p. 202, of the recent edition of the works of Mr. J. Hunter). I would ask Mr. Owen, whether any previous physiologist has shown that the *vis nervosa* of Haller, and the motive power in the experiments quoted, are *one and the same*, and that it has an important application to physiology, pathology, therapeutics, &c. I would ask Mr. Owen, whether it had been previously pointed out that the act of deglutition, that the action of the sphincters, &c., with *all* ingestion and egestion, *all* guarding of the orifices and outlets of the animal frame, were *spinal* functions, performed through special *excitor* and *motor* nerves? Mr. Owen's statement is very clear, but it is *ex post facto*. Mr. Owen's doubts are also clear, but it is admitted by me that the question is *sub judice*. *Jam satis.*

153. But I proceed to the *philosophy* of my subject. I proceed to treat of the acts of the excito-motory system. As the desig-

nation of this system implies, there is always the application of an appropriate stimulus, or cause of excitement or irritation; this is followed by the contraction of peculiar sets of muscles. It is clearly proved that the influence of the stimulus is carried along an excitor and incident nerve, to the medulla oblongata, or medulla spinalis, and that it is reflected thence along other reflex, or motor nerves. The incident excitor nerves, the medulla, and the reflex motor nerves, constitute the system. They remain, as I have already stated, after the centre of the cerebral system has been removed by experiment, or destroyed by disease. Their distribution takes place principally about the larynx and pharynx, in connection with the medulla oblongata; and about the sphincters, in connection with the lower part of the spinal marrow; and hence they especially guard the *orifices* and *exits* of the animal frame. Other parts of the system govern the acts of *ingestion*,—deglutition, and respiration;—and the acts of excretion,—of the fæces, urine, and semen. A third portion of the system gives general tone to the muscular system, and, consequently, to the limbs. I may observe that each of these actions may be represented to the *eye*, as will be seen in the subsequent sketches.

154. I now proceed to notice each of the functions of the excito-motory system particularly. Of these the figures at § 50 and 52 may be considered as the *types*.

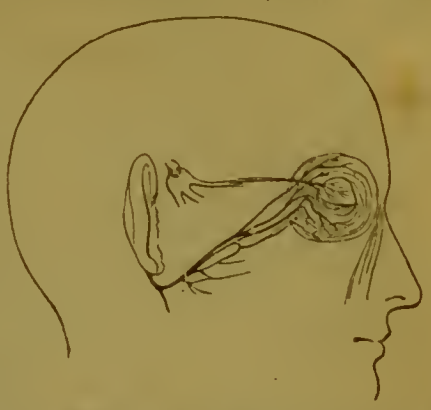
1. *The Excited Closure of the Eye-lids.*

155. This phenomenon has been described, § 118, in detailing the experiments on the horse. The general fact is, that, when the cerebral functions are annihilated in experiments on animals, and by disease in the human subject, as in the coma of apoplexy, of hydrocephalus, when *sensation* and *volition* are *extinct*, the touch of the finger or of a straw applied to the eyelid, induces its instant closure.

156. M. Magendie and Mr. Mayo fail entirely in any attempt to account for this interesting phenomenon, which may be taken as the *type* of the excito-motory actions. See § 150.

157. One of the most interesting circumstances of the true spinal or excito-motory system, is, that each of its acts can be expressed by mere lines, denoting the excitor and motor nerves involved in it, together with the central medulla. The subjoined sketch denotes the closure of the eyelids. The trifacial nerve, the medulla oblongata, the orbicular branch of the facial nerve, are the different parts of the reflex arc: or it may be expressed thus,—the excitor and motor nerves are two arcs, united by the medulla oblongata as their *key-stone*.

158. But the most remarkable circumstance connected with the closure of the eyelid, is its relation to the state of *sleep*. I have already stated, § 135 and 147, that the cerebral system alone undergoes this remarkable modification; that the true



spinal system does not sleep. There must be some remarkable reciprocity between the levator palpebræ and the orbicularis in reference to this phenomenon. When awake, the levator palpebræ is more powerful than the orbicularis; in sleep the orbicularis prevails. I believe the levator palpebræ, and, perhaps, the four *recti* of the eye, to be, of all the muscles of the animal frame, purely *cerebral* and *voluntary*, and unendowed with fibres from the excito-motory system. When awake, volition raises the eyelid. During sleep, the excito-motory property induces constant contraction of the orbicularis, as it does of the other sphincters. The eye is thus preserved from exposure during the night,—preserved from the state of inflammation with which it is attacked, when, from injury of the facial nerve, or failure of the excito-motory power, the tonic influence of the medulla is cut off, or diminished, and the action of the orbicularis is defective. See § 72. Similar observations apply to the action of the recti, compared with the trochlearis and abducens.

2. *The Act of Deglutition.*

159. The next part of the physiology of the true spinal marrow, and of the excito-motory system of nerves, relates to the act of deglutition. In treating of this subject, I must speak principally of the action of the pharynx, but also of that of the cardia.

160. 1.—*Action of Pharynx.*—If we press down the tongue with the handle of a spoon, and convey the instrument towards the root of the tongue and tonsils, an action of deglutition ensues. If, in a living animal, an incision be made in the side of the neck, and the finger be passed into the pharynx, it is immediately grasped forcibly. The same event occurs even after decapitation in a young animal. In this last case the action ceases either on dividing the nerves which intervene between the pharynx and the medulla, or by removing the medulla itself.

161. I have looked over the popular works of Dr. Bostock, M. Magendie, and Mr. Mayo, for any intimation of the real nature of the action of deglutition, and of its dependance on the medulla spinalis, in vain. The first of these authors is entirely silent on the subject. The second observes, "Thus is the second period of deglutition accomplished, by the effect of which the morsel of food passes through the pharynx, and enters the superior part of the œsophagus. All the co-operating phenomena take place simultaneously, and with great promptitude: they are not subject to the will; they, therefore, differ, in several respects, from the phenomena which belong to the first period." Mr. Mayo speaks of "the peculiar sensibility of the back part of the fauces" as being "excited," and of the act itself as being "instinctive and irresistible." Mr. Mayo adds, "if the action of deglutition be voluntarily performed several times in succession, and nothing but saliva swallowed, the parts become *fatigued*, and the operation cannot be immediately repeated." The real explanation of this last singular and interesting fact is this:—an excited act requires a stimulus or excitor; the saliva is that stimulus in the first and second acts of deglutition; but in a third, attempted promptly after the second, this stimulus is wanting; the act, consequently, fails for want of its excitor. The idea of "fatigue" is obviously fallacious.

162. In none of these authors is there the slightest allusion to the important and essential influence of the medulla oblongata in the act of deglutition.

163. 2.—*Action of the Cardia.*—The cardia opens to receive the food from the œsophagus, and closes to retain it in the stomach. It is paralysed on dividing the pneumogastric nerves. In a rabbit, in which this experiment is performed, the œsophagus is found replete with food, although it may not have eaten after the operation. The fact was first ascertained, I believe, by MM. Leuret and Lassaigne (p. 132). The pneumogastric is preeminently the internal excito-motory nerve.

164. The act of deglutition consists, then, 1, of an excited closure of the larynx; 2, of an excited action of the pharynx; 3, of an opening of the cardia. The nervous arcs which act in this apparently simple but really complicated phenomenon consist of excitor nerves *from* the larynx and pharynx, and of motor nerves *to* the larynx, pharynx, and cardia.

165. What shall we say of the apparently active dilatation of this last part,—*the sphincter of the stomach?* The act of forcing to expel the contents of the rectum produces a similar decided relaxation of the sphincter ani,—a fact perfectly familiar to surgeons who avail themselves of it, in order to effect the reduction of hæmorrhoidal tumours.

3. *Closure of the Larynx.*

166. The larynx closes accurately in every act of deglutition; on attempting to inspire carbonic acid; on the contact of a drop of water or a crumb of bread; in the act of vomiting, &c. What is the nature of this phenomenon?

167. If, in a living animal, or in an animal deprived of the cerebral lobes, or in the recently separated head of a young animal, the rima glottidis be touched with a feather, or probe, the glottis immediately closes firmly. This phenomenon ceases instantly, in the latter case, on the separating the larynx from its connections with the medulla oblongata, by a sharp instrument, within or without the spinal canal, or on destroying the medulla itself. It is, therefore, plainly dependant upon the medulla, and upon excitor nerves which proceed to, and motor nerves which proceed from, this part of the nervous system. It is a reflex, excito-motory act of the superior laryngeal, and the medulla oblongata.

168. M. Magendie has written expressly upon the action of the larynx; and though he concludes, from experiment and dissection, that the closure of the larynx depends upon the superior, and its opening upon the inferior laryngeals; and that it is essential that *all* be divided, in order that the larynx may remain open and immoveable, yet he is perfectly silent upon the essential agency of the medulla oblongata in all excited actions of the larynx. Mr. Mayo ascribes the closure of the larynx from the contact of carbonic acid, water, or mercury, to "the close consent between the sentient mucous surface of the larynx and its muscles."

169. I have thus demonstrated the essential connection of the eyelid, the pharynx, and the larynx, in their acts of closure, with nerves going to and from the medulla oblongata, and with the medulla oblongata itself. No previous physiologist has seen that these apparently simple acts are really very complicated, and that they are *spinal* acts. That deglutition is a *spinal* act, is a new view of the subject. I refer you *particularly* to the recent translation of Professor Müller's "Handbuch," by Dr. Baly, for proof of this assertion. I must next proceed to treat of another act of the same system, the most immediately essential to life of all, viz.:—

4. *The Respiration.*

170. That the respiration is a mixed function, and partly dependent on cerebral agency, or volition, is shown by the effect of profound attention, sleep, stupor, the sinking state, &c. During attention, or sleep, the respiration becomes irregular and audible; in stupor it is noisy and stertorous; in the dying state it is impaired and catching. In *all* these cases the respiratory movements are instantly improved by rousing the per-

son to sensibility and acts of volition. The partial dependence of respiration on the excito-motory power, is made manifest by the division of the pneumogastric nerves; the acts of respiration immediately become much more frequent; and, as M. Magendie expresses it, "the animal appears to devote particular attention to it."

171. From the multitude of opinions respecting the acts of inspiration, it will be sufficient to select three, to be noticed in this place.

172. First. Dr. Wilson Philip and Mr. Mayo consider the acts of inspiration as acts of volition, or of conscious effort.

173. Secondly. Dr. Bostock, Dr. W. Philip, and M. Brachet, consider the acts of inspiration as dependent upon the pneumogastric nerves, as nerves of sensation.

174. Thirdly. Legallois, Sir Charles Bell, M. Flourens, Professor Müller, &c., regard the acts of inspiration as dependent upon the medulla oblongata as their *primum mobile*.

175. It appears to me to be a sufficient reply to the opinion that respiration is an act of the will, or of conscious effort, that it is repeated when the cerebral lobes, the seats of volition and consciousness, are removed, and when all indubitably spontaneous acts have ceased.

176. And it appears to be a sufficient reply to the idea, that inspiration depends upon an uneasy sensation conveyed to the sensorium by the pneumogastric nerves, that it is repeated when these nerves are divided. Dr. Bostock and Mr. Mayo speak of this act, and of the agency of the pneumogastric nerves, as imperfectly understood. M. Brachet, speaking of the experiment in which the pneumogastric is divided, observes,—"In this case we must not attribute the continuation of respiration to the necessity which is felt of respiring, but to the *habit* which the cerebro-spinal nervous system has contracted, of causing the respiratory muscles to move."

177. I must now make some equally brief observations upon the opinion, that the medulla oblongata is the *primum mobile* of respiration. It is founded upon the facts, that the cerebrum may be removed from above downwards, and the spinal marrow from below upwards, without suspending the acts of inspiration, if the medulla oblongata, at the point of origin of the pneumogastric, be preserved entire. Yet, as M. Flourens observes, "the evident proof that it is neither solely, nor even precisely, because it is the origin of the eighth pair, that the medulla oblongata is the *primum mobile* of respiration is, that the two nerves may be cut, and respiration (although rendered constrained and laborious), would, nevertheless, subsist for a very long period." From these several experiments we should be apt to conclude, that neither the cerebrum nor the pneumogastric nerves, are necessary for the acts of inspiration, since these acts are renewed when either is removed. The truth, however, is, that, although the acts of inspiration continue without *either*, they will not continue without *both*. Each may be removed *singly*, but if *both* be removed, the inspirations cease, as in the experiment of dividing the medulla oblongata at the origin of the pneumogastric nerves, an experiment hitherto unexplained. In fact, inspiration may be a voluntary act, induced by the agency of the cerebrum, the pneumogastric nerves being divided; or it may be an excited act, excited through the agency of the pneumogastric nerves, the cerebrum being removed. If, in this latter circumstance, the pneumogastric nerves be divided, the acts of inspiration cease. In this last fact we have, then, the proof that the medulla oblongata is not the *primum mobile* of respiration, but that the pneumogastric nerve is that *primum mobile*, as an excitor of respiration, essential and necessary when the agency of volition, with its organ, is removed,—an important conclusion, by which many difficulties, and an interesting question, are at once solved.

178. The acts of inspiration, then, are acts of the excito-motory, or true spinal system. Ordinary inspiration is excited through the medium of the pneumogastric nerve, but regulated and controlled by the volition. During sleep, and in coma, the influence of volition is diminished, or annihilated, and the respiration becomes audible, or even stertorous. Respiration is, therefore, as stated of old, a *mixed* function, as, indeed, are many of the acts of the excito-motory system, excited through particular nerves, but regulated or modified by volition.

179. This remark leads me to observe, that the pneumogastric is not the only excitor of inspiration; inspiration is equally excited through the fifth and spinal nerves,—a fact proved by the familiar phenomena induced by dashing cold water upon the extremities of the former in the face, and by impressing the latter by a similar influence on descending into the cold bath. The first act of inspiration in the newly-born infant is probably excited through the medium of the fifth and spinal nerves conjointly, by the contact of the atmosphere, as the first acts of the expulsion of the fæces and urine are excited during the similar contact of the atmosphere with the extremities of the spinal nerves.

180. My friend, Dr. Heming, witnessed an interesting fact in proof of this opinion. The infant just born, and covered by the bed-clothes, did not breathe; Dr. Heming, after waiting a few seconds, proposed to himself to adopt some measure for this asphyxia, and lifted up the bed-clothes. The contact of the cool atmosphere instantly

excited an act of inspiration. This view of the subject is confirmed by some facts in pathology, to be detailed shortly, and by some experiments.

181. In the first place, if the pneumogastric nerve be laid bare on the neck of a donkey, and irritated by the forceps, an act of inspiration, followed by an act of deglotition, is actually and instantly excited.

182. In the second place, we have to consider what is the stimulus, or exciting cause of inspiration. I must adduce, in this place, the celebrated experiment of Hook, given in a very early volume of the "Transactions of the Royal Society," in which a stream of atmospheric air was driven through the trachea, the lungs, and incisions made through the pleora, in a living dog; the animal made no effort to inspire whilst this stream was continuous; but when it was interrupted, the efforts at inspiration were violent and convulsive. In other words, when the air respired was unmingled with the carbonic acid exhaled from the lungs, no act of inspiration was excited; but when it became charged with that gas, efforts at inspiration were immediately made. Is carbonic acid, then, in the air-cells of the lungs, and in contact with the fibrillæ of the pneumogastric nerves, the exciting cause of inspiration?

183. Other facts confirm this idea. Dr. Faraday particularly mentions the fact, that the respiration can be suspended longer after repeated deep inspirations, by which the air of the lungs is completely renewed, than in ordinary circumstances. Divers breathe less frequently in proportion as they breathe an atmosphere under augmented pressure, and consequently condensed,—the *proportion*, or bulk, of carbonic acid evolved being less speedily completed. Lastly, the number of respirations is gradually augmented, with gasping, as the proportion of carbonic acid in a given quantity of gas, in which an animal is confined, becomes augmented. It would be interesting to repeat this experiment, taking the precaution of keeping the proportion of oxygen gas the same. In a word, what pure carbonic acid is in contact with the rima glottidis, diluted carbonic acid is in the lungs—an exciting cause, acting through the medium of the excito-motory, or true spinal system.

184. This principle is corroborated by a circumstance, of which it alone affords an explanation. It has been observed, that there is always a certain proportion maintained between the number of pulsations of the heart and of respirations. This proportion obtains from the highest degree of activity in an animal, even to the most complete quiescence in hybernation. The evolution of carbonic acid is greater in proportion to the rapidity of the circulation; this carbonic acid is itself the exciting cause of inspiration; this act will, therefore, be repeated more or less frequently as the circulation, and with it the evolution of carbonic acid, is more or less rapid. I believe this law of the proportion between the circulation and the respiration, has not been explained before.

185. But the experimentum crucis consists in first carefully removing the cerebral lobes with the cerebellum, and then dividing the pneumogastric nerves within the cranium, or spinal canal, or in the course of the neck. Respiration subsists as a purely excito-motory act, performed through the agency of the pneumogastric nerves, when the cerebrum is removed, and it ceases immediately when these nerves are then divided.

186. It appears from these various facts, that the acts of inspiration are excited acts, and excited through the medium of several excitor nerves. These may be arranged thus:—

1. *The Trifacial.*
2. *The Pneumogastric.*
3. *The Spinal.*

But if these constitute the *excitor* nerves of inspiration, the medulla oblongata must be viewed as the organ which combines the various muscles into a system; and the various nerves comprised in the respiratory system of Sir Charles Bell, are the true *motory* nerves of respiration. I may take this opportunity of remarking that, beautiful as it is, Sir Charles Bell's system of inspiratory nerves is defective from *two* circumstances; first, it is confined to the motor nerves, of the respiratory system; secondly, it is confined to respiration, when it ought to be extended to the whole of that system, which I have ventured to denominate excito-motory, and which relates, not to respiration alone, but to all the acts of ingestion and egestion.

187. I might further adduce, if it were necessary, experiments of M. Dupuy, M. Cruveilhier, and of Sir Astley Cooper, in favour of this view of respiration. M. Dupuy, forty hours after having divided the pneumogastric nerve in the horse, found irritation of the divided end of the upper portion to induce great labour in respiration. M. Cruveilhier, after destroying the function of the cerebrum, found respiration to cease instantly on dividing the pneumogastric near its origin. Sir A. Cooper observed that the respiration became gradually slower on dividing the pneumogastric and to cease instantly on compressing the carotid and vertebral arteries simultaneously, whilst the action of the diaphragm ceased on dividing the phrenic nerves. These facts prove the respective influence of the incident, excitor, nerve—the pneumogastric; of the centre of the system—the medulla oblongata; and of the reflex motor nerve—the diaphragmatic.

188. In the separated head of the turtle

in act of respiration is excited either by irritating the nostril, the larnyx, or the cut surface of the spinal marrow. The action is alike—equally excited—in all.

189. The pneumogastric pursues a siugular course in fishes. After giving branches to the bronchiæ, it proceeds along each side of the body to the tail. Mr. Owen calls these the "enigmatical nerves," and an enigma will they be, until the excito-motory system is *understood* by those who pretend to criticise it.

5. *Closure of the Sphincter Ani.*

190. The sphincter ani and cervix vesicæ preseut precisely similar phenomena with the larynx and pharynx. In a horse, rendered insensible by a blow of the poleaxe, the sphincter was forcibly contracted, and the tail raised, on stimulatiug the border of the anus; these phenomena ceased either on separating the sphincter from its counection with the spiual marrow, or on destroying the spinal marrow itself: the excitory aud reflex action of the medulla, and its influence on the sphincter are therefore obvious. Dr. Alison describes the action of the sphincters in one work (*Outlines*, 1833, p. 7) as dependant upon what he designates tonicity, a property of the muscular fibre; in another (*British and Foreign Med. Review*, vol. iii. p. 33), as belonging to the class of sympathetic actions. It is plain, from this discrepancy of opinion in the same author, that there was nothing defiuitive in onr knowledge ou this subject, until I proved that the action of the sphincters, like that of the orifices, depends on the excito-motory property, acting through iucident, excitor nerves, the spinal marrow, and reflex, motor nerves.

6. *Action of the Expulsors.*

191. If, in a turtle, after the removal of the tail aud the posterior extremities, with the rectum, and of course with a portion of the spinal marrow, water be forced into the intestinc, by means of Read's syringe, both the cloaca and the bladder are fully distended before any part of the fluid escapes through the sphincter, which it then does on the use of much force only, and by jerks. If, when the cloaca is distended, the integuments over it are stimulated, the water is propelled to a considerable distance. The event is very different on withdrawing the spinal marrow: the sphincter being now relaxed, the water flows through it at once, in an easy continuous stream, with the application of little force, and without inducing any distention of the cloaca. The action of the sphincter, and of the expulsors of the cloaca, in the turtle, and its dependance on the spinal marrow, are distinctly proved by this interesting experimeut.

7. *Acts of Generation.*

192. Erection of the penis may be an excito-motory act. It was induced in the patieuts with injury or disease of the spinal marrow, whose cases have been already noticed, each time the catheter was introduced iuto the urethra,—the patients themselves being unconscious either of the contact of the instrument, or of its effect.

193. That the emission of semen depends upon the same excito-motory function of the spinal marrow, is equally obvious. In ordinary circumstauces it is excited through the influence of the nerve termed the dorsalis penis. It has been excited, in experiments made by M. Segalas, by acting immediately on the spinal marrow.—"If, in a male guinea-pig, of which the brain has been laid bare, says this physiologist, a stilette be plunged into the cerebellum, *so as to arrive at the upper part of the spinal marrow*, *erection* is produced; if the stilette be then introduced into the vertebral columu, as far as the lumbar region, *ejaculation* takes place, whilst the bladder, if it were full, still preserves its contents. The same phenomena are observed in decapitated guinea-pigs, when a similar operation is performed with a stilette from above to below in the spinal marrow." This fact is confirmed by a remark of the late Mr. Earle,—that priapism exists in injury of the spinal marrow, only when that injury is in the *neck*.

194. I may revert to the case of the act of deglutition; deglutition cannot be performed several times in rapid succession, for want of the presence and stimulus of the saliva. In the same manner the act of ejaculation requires the *local* stimulus of semen.

195. That the grasp of the Fallopian tubes is excited on the same principle is extremely probable; and that the action of the uterus belougs to the samc excito-motory system seems to be proved by the occnrrence of expulsion of the fœtus after the cessation of respiration. Such an event is noticed by Professor Müller, and a recent case in point is given by Mr. Ingleby, of Birmingham.

196. In this manner we observe that while all the orifices of the animal frame, with the acts of ingestion, are under the influence of the reflex excito-motory function of the spinal marrow, the sphincters and expulsors also act as parts of the same system.

8. *The Tone of the Muscular System.*

197. Of this function the type has been given already. There is another phenomenon belonging to this system which demands our attention,—the tone of the muscular fibre throughout the animal frame. Two rabbits were taken: from one the head was removed; from the other, also, the head was removed, and the spinal marrow cautiously destroyed by a sharp instrument; the limbs of the former retained a certain degree of firmness and elasticity; those of the second

were perfectly lax. The difference was most obvious. On the following day the limbs of both were found equally rigid from the contraction of the muscular fibre from its irritability.

198. The dependance of the muscles on the influence of the spinal marrow, for tone, is extremely obvious in the turtle.

199. The limbs and tail of a decapitated turtle possessed a certain degree of firmness or tone, recoiled on being drawn from their position, and moved with energy on the application of a stimulus. On withdrawing the spinal marrow gently out of its canal, all these phenomena ceased. The limbs were no longer obedient to stimuli, and became perfectly flaccid, having lost all their resilience. The sphincter lost its circular form, and its contracted state; became lax, flaccid, and shapeless. The tail was flaccid, and unmoved on the application of stimuli.

200. It is perfectly obvious, from this experiment, that the tone of the muscular system, and the action of the limbs on the application of stimuli to the skin, are modifications of the same function. Both coexist, or cease, with the spinal marrow.

9. *The Seat of the Passions.*

201. There is good reason to conclude, as I have already stated, that the cerebrum is the seat of the ψυχη, and of the *intellectual faculties*. There is equally good reason to believe that the medulla oblongata is the seat or nervous organ of the manifestation of the *appetites* and *passions*.

202. In the idiot, in whom the cerebral lobes are struck with such atrophy and defective development as to annihilate every vestige of intellect, the appetites are frequently not only unimpaired, but unnaturally strong: the appetite for food, sexual excitement, anger, and terror, are manifested in their turns in a remarkable degree.

203. The arm which is totally paralysed to volition or voluntary motion, in hemiplegia, is strongly agitated by surprise and other emotions. The seat of these emotions is, therefore, placed *lower* down in the nervous system than the seat of volition, and of the disease; whilst that of passion is manifested in the most distinct manner. The case is very different in paraplegia: here, the influence of the passions or emotion, as well as of volition, is totally cut off by the disease; that disease is, therefore, situated *below* the seats of volition and of the passions.

204. Have we not, in these cases, evidence of the actual seat of the passions? Is not this seat obviously placed *below* the seat of the disease in *hemiplegia*, and *above* that of the disease in *paraplegia*? And, if so, is not this seat the medulla oblongata?—the established centre and combiner of the acts of deglutition, and of respiration,—acts so important in reference to the appetite for food, and for air, the latter of which is affected in so extraordinary a manner in the exercise of the remaining one, and, indeed, in all the emotions and passions.

205. I mention this subject thus briefly only to propose it as a subject for future inquiry, in the course of these researches, and to render this sketch of the nervous system a little less incomplete. No one can see more clearly than myself how much remains for observation to accomplish.

206. It is interesting to remark that the passions affect precisely those organs of ingestion or egestion which are known to be particularly under the influence of the spinal system: grief induces a painful sense of choking; fear relaxes the sphincters; all the passions affect the respiration; a disgusting object induces sickness.

207. Before I conclude, I must inform you that there is a paper in the last number of the "Edinburgh Medical Journal" (for January, 1838), by Dr. J. Read, of which it is impossible for me to speak too highly, to which, however, a note is appended (p. 156), of which I cannot speak in similar terms of praise. Dr. Read's experiments confirm my own in every respect, and, I think, add nothing to what I had done. But they are invaluable additions to our store, and bear the stamp of great accuracy. It is important to bear in mind, in similar experiments, that the *trunks* of nerves by no means always display the properties possessed by them, in the points of their ultimate distribution. This last fact is proved by an experiment. Let a frog be decapitated, and let the skin along the spine be divided longitudinally, and raised with the forceps; many minute cutaneous nerves will be seen; now, I have not been able to excite motions by irritating these nerves, although nothing is so easy as to effect this by irritating the skin in which they are distributed.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, February 24, 1838.]

LECTURE IV.

THE ANATOMY OF THE NERVOUS SYSTEM.—*Mr. Owen's opinions examined. Origins of the excito-motory nerves. Sketch of the true spinal system.* PATHOLOGY OF THE NERVOUS SYSTEM.—*Cerebral phenomena. Pathology of the facial nerves. Hemiplegia and paraplegia. The direct and crossed effects of cerebral disease. Localisation of cerebral diseases. Convulsive affections belong to the true spinal system. Epilepsy, chorea, &c. Diseases of the meninges. Convulsion from hæmorrhage.* THE THERAPEUTICS OF THE NERVOUS SYSTEM.—*General remarks. Sedative and exciting agents. Removal of Causes. Questions which remain to be investigated.*

GENTLEMEN:—I now proceed to treat of

II. THE ANATOMY OF THE NERVOUS SYSTEM.

208. The figures at § 22, 56, and 88, will give you distinct ideas of the general forms of the *cerebral, true spinal,* and *ganglionic systems.* Imagine them superposed and blended, and you will have a just idea of the entire nervous system. Any view short of this is an inadequate view of this important subject.

209. The interesting question is this. Is there a *distinct* kind of nervous fibre or element appropriate to *each* of these systems? Mr. Owen observes:—"I cannot perceive the necessity of a distinct class of excitable nervous fibres for transmitting an impression to the motive fibre through the medium of the spinal chord and brain; and of another class of nervous fibres for transmitting an impression to the motive fibre through the medium of the spinal chord alone; still less can I perceive the necessity for one class of exciting or motive fibres for transmitting the stimulus to the muscular fibre from the brain and spinal chord, and of another and distinct class for transmitting a stimulus received from the spinal chord independently of the brain." The question, however, is not whether Mr. Owen can "perceive the necessity" for these things, but whether they really do exist in Nature.

210. Two things are certain:—1. It is impossible through the medium of punctures, lacerations, &c. of the cerebrum, cerebellum, and certain nerves, to excite motion. 2. That it is impossible to puncture or lacerate the tubercula quadrigemina, the medulla oblongata, the spinal marrow, and other certain nerves, *without* exciting motion. To some, the fibres or elements of the nervous system which possess, and which do not possess, the excito-motory property, may appear the same. They may not be able to "perceive" the difference. To *me*, it seems obvious that, with each property, a certain organisation must be associated. At any rate, *physiological* properties are not less important than anatomical structures.

211. Now, if the cerebrum and the medulla oblongata possess different properties, the nerves, refferent or efferent, may do the same. And if these two properties are *blended* in the spinal marrow, they may be so in the course of certain nerves, and yet the textures be as different as that of the cerebrum and that of the true medulla spinalis. In other cases, the two kinds of fibres may exist separately.

212. This is, in my opinion, a far more *probable* view than that which supposes that "the excitable fibres are those usually termed sensitive," &c. But the real philopher will pursue his investigation in search of truth, until that truth is discovered. I have proposed the question before us for subsequent inquiry (see p. 657, § 71, of these lectures, and p. 50 of my Memoirs); and I still propose to prosecute that inquiry.

213. Meantime I will observe that there is *one* nerve which *is* excitor and motor, *without* being either sensitive or voluntary, and that is the pneumogastric at the cardia.

214. Let the physiologist pursue the track opened by M. Flourens, and let him experiment and determine what nerves and what parts of the nervous system are endowed with the excito-motory power; and vice versâ; proseeuting the inquiry in those classes of animals which nature has, as it were, left dissected to our hands. Let experiment be as a scal, el, and let physiology and anatomy be as allies. In this manner we shall detect what parts of the nervous system are simple, what arc compound. We shall see that the trifacial is, in its different branches, sentient, incident-exeitor, and nutrient, following Nature, and not presuming to simplify what is complicated.

215. I will now present you with a

Table of the Cerebral, or Sentient and Voluntary System.

II. *The Cerebrum and Cerebellum, the Centre of the System.*

I. *The Sentient Nerves:—*
1. The olfactory.
2. The optic.
3. The trifaeial.
4. The acoustic.
5. The glosso-pharyngeal.
6. The posterior spinal.

III. *The Voluntary Nerves.*
1. The oculo-motory.
2. The minor portion of the trifacial, or mastieatory.
3. A part of the facial.
4. The myo-glossal.
5. The anterior spinal.

This table corresponds with the plate in § 22. They are to be studied together. In pourtraying this system, I have, therefore, § 22, represented double lines,—of sensation and volition,—proceeding from the lower and upper extremity, and terminating, or originating in the cerebrum.

216. Let this sketch be compared with those at § 56 and 64, which represent the incident, downward, upward, and reflex course of the excito-motory power in the medulla oblongata and spinalis, aud the broad distinction between the two becomes at once apparent.

217. It becomes obvious that, if a nerve be compounded of sentient and excitor filaments, it has, probably, two origins, one in the cerebrum, the other in the medulla. The same remark is true of the nerves compounded of voluntary aud motor fibres. Is it possible to traee this structure iu any part of the zoological series? What an interesting subject for the sealpel and for experiment.

218. The trifacial and spinal are decidedly compouud nerves *in function*; the voluntary nerves are probably all motor too, except, *perhaps*, the levator palpebræ. Whether they be compound in *structure*, is, as I have said, *the* question.

219. I now present you with a

Table of the True Spinal, or Excito-Motory System.

II. *The True Medulla Oblongata and Medulla Spinalis, the Centre of the System.*

I. *The Incident, Excitor Branches.*
A. The trifaeial, arising from—
1. The eyelashes.
2. The alæ nasi.
3. The nostril.
4. The fauces.
5. The face.
B. The pneumogastric, from—
1. The pharynx.
2. The larynx.
3. The bronchia.
4. The cardia,—kidney, and liver.
C. The posterior spinal, arising from—
1. The general surface—
2. The glans penis, vel clitoridis.
3. The anus.
4. The cervix vesicæ.
5. The cervix uteri.

III. *The Reflex, Motor Branches.*
A. The troehlearis } Oculi.
B. The abducens }
C. The minor portion of the fifth.
D. The facial, distributed to—
1. The orbicularis.
2. The levator alæ nasi.
E. The pneumogastric, or its accessory.
1. The pharyugeal.
2. The laryngeals.
3. The bronchial.
4. The cardiac, &c.
F. The myo-glossal.
G. The spinal, distributed to the—
1. Diaphragm, and to
2. The intercostal, and } Muscles.
3. The abdominal }
H. The sacral, distributed to—
1. The sphineters.
2. The expulsors, ejaculators, the Fallopian tubes, the uterus, &c.

220. In the sketch of the true spinal or excito-motory system given in § 56, as in the above table, the excitor nerves are are arauged on the left hand, and the motor on the right, the spinal marrow intermediately. The pneumogastric nerve is the only exceptiou to this rule; *it* is almost throughout both excitor and motor, and is placed on the lcft.

221. I believe an objection has been raised against designating a nerve, known to be a sentient nerve, an excitor nerve; but the question is not one of words, but of facts. Is the trifacial a sentient nerve? If so, let it be so designated. Is it also an excitor nerve? If so, there is the same reason for designating it by this epithet. In short, it is not only seutient and excitor, but it is probably

nutrient too; and any view of the subject short of this, is distant from the truth. In the same manner the pneumogastric must be viewed, not as a mere sentient or secretory nerve, but as emphatically *the internal excito-motory nerve.*

222. I repeat that in the *anatomy* of the excito-motory system there is a rich mine to be explored. In the investigation two modes may be pursued—dissection and experiment. Sir Charles Bell applauds the former, M. Flourens the latter; but all must be agreed that these two methods should be regarded "not as rivals, but as allies."

223. It may be received as a principle, that every part of the nervous system which is endowed with the excito-motory power, belongs to this system, whether this power be exerted in the direction of the nerves, *from* or *towards* the nervous centres. We have, in a simple experiment, therefore, an an easy mode of ascertaining what part of the general nervous system belongs to that subdivision of which I am treating. It would be interesting to determine this question in reference to each part of the nervous system of the various classes of animals.

224. The next inquiry would be, What are the special motions produced by stimulating given incident nerves? The most usual effect produced, is a motion of the limbs. But, in other instances, we have acts of inspiration, of deglutition, of expulsion,—of closure in the eyelids, larynx, pharynx, and the sphincters:—interesting facts, which speak a physiological language, and assign distinct and special offices to certain excitor nerves.

225. These excitor nerves may be viewed as *guards* of the orifices and exits of the animal frame. Thus:—

I. *The Trifacial Guards:*—
1. The eye.
2. The nostril, the ear,—in the cetacea.
3. The fauces.

II. *The Pneumogastric:*—
1. The larynx, the bronchia.
2. The pharynx, the cardia.
3. The ureter, the gall-duct.

III. *The Spinal Nerves:*—
1. The rectum.
2. The bladder.
3. The vesiculæ seminales.
4. The uterus.

To each part of this series of excitor nerves, there is a corresponding set of motor nerves.

226. I must especially point out in this, what I deem the true view of the respiratory system. It consists of the *excitors* of respiration, in addition to the respiratory system of Sir Charles Bell.

System of Respiratory Nerves.

I. *The Excitors:*—
1. The trifacial.
2. The pneumogastric.
3. The spinal.

II. *The Medulla Oblongata.*

III. *The Motors.*
1. The intercostal.
2. The diaphragmatic.
3. The lower spinal, &c.

227. I need scarcely repeat that the respiratory system is only a part of the true spinal or excito-motory system.

228. In reply, finally, to the remarks of Mr. Owen, I will beg you, once more, to consider the facts detailed, § 150, p. 687, comparing Mr. Mayo's "Physiology," 4th edition, p. 303.

III. The Pathology of the Nervous System.

229. The subject which I now enter upon, will have a peculiar interest for you, preparing yourselves as you are for *practice.*

230. In order to conceive a clear idea of the pathology, we have only to imagine the physiological phenomena already noticed assuming a pathological character. Now, the force of these phenomena may be augmented, diminished, or annihilated.

231. In regard to the cerebral functions we have, in the sentient nerves, pain or insensibility; in the cerebrum itself erroneous perceptions, judgments, and volitions, or delirium; or a total deficiency of these faculties, or coma; in the motor nerves, continual voluntary actions, or paralysis.

232. We may take the face, with its sentient and motor nerves, to illustrate a part of this subject; we may have morbid sensibility in the face, and this may assume the form of *tic douloureux*; we may, on the other hand, have loss of sensibility; this may arise from disease of the opposite hemisphere, or of the fifth nerve, within or without the cranium. The former case constitutes hemiplegia of the face; the latter cases have been particularly described by Sig. Bellingeri and Sir Charles Bell. We have in these affections interesting calls upon our resources for the diagnosis.

233. In hemiplegia the loss of sensation is rarely complete, and there is usually paralysis of the muscles of the face, and the susceptibility of the nostrils to irritants is unimpaired; this was the case in a patient whom I recently examined, by the kindness of Dr. Watson, in the *Middlesex Hospital.* In the case of disease of the fifth, within the cranium, the loss of sensibility is frequently complete; the nostril has also lost its susceptibility to the impression of stimuli, and eventually the eye, not being nourished, shrinks and collapses; the power of the masticating muscles is impaired, but the face is not distorted by any *apparent* paralysis.

234. In paralysis of the face, from disease of the opposite hemisphere, the eyelid can be closed, as in this representation; in

paralysis of the facial nerve the orbicularis is paralysed, as you may observe in this. What is the rationale of this difference? The seventh, like the fifth, is a compound nerve; as the latter embraces excitor and ganglionic filaments, which are not involved in the attack of hemiplegia, so the former comprises a branch belonging to the excito-motory system, which is not affected in disease of the cerebrum. These I have not thought it necessary to designate particularly.

235. Both the fifth and the seventh pairs of nerves are, then, more complete than they are represented to be by Sir Charles Bell; the former includes excitor and nutrient nerves, with the nerve of sensation, and it has appropriate origins, distributions, and offices; of its offices sensation alone is impaired by cerebral disease, but all are annihilated by the pressure of a tumour within the cranium; the seventh comprises pure cerebral and true spinal nerves; the cerebral only is affected in hemiplegia, and the orbicularis retains its power; all are paralysed by the pressure of a tumour below the ear, and we have paralysis of the sphincter of the eyelid. This remark leads me to observe, that *ptosis* is a cerebral paralysis, whilst *lagophthalmia* is one of the true spinal system; to the latter system *strabismus* also frequently belongs.

236. It was well known to the ancients that disease in one hemisphere of the brain induces paralysis in the opposite side of the body.

237. This fact has been confirmed by modern pathologists. It has been fully ascertained that disease confined to one hemisphere of the cerebrum, or of the cerebellum, and to one side of the mesial plane in the tuber annulare, constantly affects the *opposite* side; whilst disease, confined to one of the lateral columns of the medulla oblongata and medulla spinalis, affects the *corresponding* side of the muscular system; the encephalon has a *crossed effect*, the medulla a *direct effect*.

238. It has been further ascertained that in *experiments*, lesions of the encephalon induce *paralysis only*; whilst lesions of the medulla oblongata and spinalis induce *convulsion*, or *paralysis*, according to its severity; hence it becomes an important question to determine the cause of convulsive affections in *disease* of the encephalon; to this question I shall particularly direct your attention immediately.

239. Such are the *facts* in reference to this subject. I must now briefly state to you, that formerly Sancerotte, in his Prize Memoir, presented to the *Académie Royale de Chirurgie* in 1768, and, more recently, MM. Foville and Pinel-Grandchamp, M. Serres, M. Lacrampe-Lunstan, and M. Bouillaud, have attempted to show, that besides this crossed effect of the cerebrum, affections of the corpus striatum, or its *middle lobe*, induce paralysis of the *inferior* extremities, whilst similar affections of the thalamus, or its *posterior lobe*, induce paralysis of the *superior* extremities; so that if this opinion were true there would be a *doubly crossed effect*. I use this phrase as a sort of *mnemonic* for you, if you should wish to speak of these opinions, for I fear I must call them by that name. M Lallemand and M. Andral, after an examination of an extensive series of facts, have declared that the statement is without foundation. M. Bouillaud has further attempted to show that disease, or lesion, of the *anterior lobe* of the cerebrum leads to a loss of the power of articulation; but this opinion is equally contested by the two authors whom I have just quoted.

240. I must now briefly notice an attempt to *localise* the affections of the brain, of a different kind, but equally disputed by these pathologists. MM. Delaye and Foville have stated that the gray or cortical substance is principally affected in *mania*. M. Bouchet and Cazauvieilh, whilst they agree with MM. Delaye and Foville in their view of the pathology of mania, contend that in *epilepsy* it is, on the contrary, the white or *medullary* portion of the brain which is diseased.

241. The tubercula quadrigemina alone have a crossed effect both of convulsion and paralysis.

242. M. Ollivier observes, that a hæmorrhage into the tuber annulare only paralyses the movements; M. Cruveilhier, on the contrary, asserts that such an affection destroys the sensations and the movements, but leaves the intellect uninjured. How many questions, then, still remain for future inquiry to solve.

243. I need scarcely add in this place, that in those cases in which hæmorrhage occupies an extensive space, affecting both hemispheres of the cerebrum, as in meningeal hæmorrhage at the summit, or at the base of the brain, in extensive hæmorrhage within the brain, extending from one hemisphere to the other, or into both ventricles, *general* paralysis is observed; the same event takes place in the cases in which a clot is formed in the mesial line, in the tuber annulare, the nodus encephali, as it has been termed.

244. Apoplexy and general paralysis are always serious; they are still more so when they affect the excito-motory system, inducing dysphagia, stertor, relaxed sphincters, &c.

245. Legallois, impressed with the idea that the spinal marrow was endued with the faculties of sensation and volition, experienced great difficulty in explaining the occurrence of paralysis from disease of the cerebrum. He observes:—"Even if no means be perceived of reconciling them, it would still remain true, on the one hand,

that an affection confined entirely to the brain, may take away sensation and voluntary motion from one half of the body; and, on the other hand, that sensation and voluntary motion may subsist and be kept up in a decapitated animal. However opposed these facts may appear to be, we must remember that two facts well established can never exclude one another, and the contradiction which we imagine to exist, is caused by some intermediate circumstances, some point of contact which escapes us." The facts and principles which have been detailed in this lecure enable us readily to remove this difficulty, and to account for the paralysis induced by disease of the cerebrum, on one hand, and for the movements of an anencephalous fœtus in utero, or of a decapitated animal on the other. The paralysis consists in the loss of voluntary motion; the movements of the anencephalous fœtus result from the agency of the excito-motory system. Legallois' error was that of mistaking the phenomena of the excito-motory system for sensation and voluntary motion; and his difficulty naturally arose out of this error. There is no real discrepancy between the two orders of facts to which Legallois refers.

246. But I must hasten on. I will close my remarks on this subject by stating, that however distinct the cerebral and true spinal subdivisions may be, they exert an influence upon each other which is essential to the well-being of the individual. The anencephalous fœtus, though it may be born alive, and even live for some hours, is not *viable;* it must *soon* die. Apoplexy and hydrocephalus destroy the patient by destroying the cerebral functions merely. During sleep even, although this be *chiefly* an affection of the brain, the functions of the true spinal marrow are somewhat impaired; the respiration is noisy, frequently slightly stertorous, and irregular. Yet the respiration does proceed, acts of deglutition take place, and the sphincters do their office. Still a marked distinction between the cerebral and the true spinal functions, is, that the former are partly suspended in *sleep*, and entirely in *coma*, whilst the latter are unimpaired. In sleep and in coma the eyelash is susceptible to the slightest stimulus, and the orbicularis, the sphincter of the eyelid, and the other sphincters, with the muscles of the larynx and of the respiration, do their office. This state of things cannot last long, however, in coma; because the integrity of the cerebral funtions is essential to the continuance of the true spinal and the other functions of the animal economy. Hence the fatal omen attached to stertor, choking, relaxation of the sphincters, and other morbid affections of the true spinal functions, in cases of cerebral disease already noticed.

247. On the other hand, if the excito-motory system be impaired in its functions, the acts of the cerebrum are interrupted. The volition is perfect in chorea, in stammering; but the voluntary movements, from the morbid condition of the excito-motory system, are irregular and imperfect. I have this day witnessed a remarkable fact:—a patient who had suffered a degree of loss of power of the left arm and leg, from a protracted epileptic seizure, and who could not close the hand firmly otherwise, could grasp any object placed in it, with considerable force.

248. I must not, however, extend my observations on the cerebral system, but hasten to that in reference to which I particularly wish to engage your interest. That I shall readily do this, on account of the part which I myself have taken in its elucidation, I have no doubt; but I rather wish to do so, on account of the intrinsic and practical value of the subject,

249. The *first* remark I would make is a very comprehensive one. I believe that the *whole* order of spasmodic and convulsive diseases belong to this,—the excito-motory division of the nervous system; and that they cannot be understood without a previous accurate knowledge of this system.

250. Another remark is equally important. *All* these diseases have their source in *one* of three parts of the excito-motory system: the first series have their origin in the spinal marrow itself, the axis, or centre of the system; I shall designate these cases by the epithet *centric;* the *second* series have their source in the excitor nerves, consequently at a distance from that centre; I shall denominate them the *eccentric*. A third series occurs, like the spasmodic tic of the seventh pair, in the course of the motor nerve. I will soon convince you that this distinction is not an unimportant one; the prognosis depends upon it almost entirely; the centric diseases are, for the most part, incurable; the eccentric diseases, on the contrary, as generally with some particular exceptions, admit of cure. I will briefly illustrate these positions:—you have two little patients with croup-like or other convulsions; one of these cases may arise from disease within the cranium, or spinal canal; it will most probably prove incurable; the other may arise from dentition, a cause acting upon an excitor branch of the fifth; I need scarcely add, that it will generally yield to the prompt and energetic use of the appropriate remedies.

251. A third remark is, that in *all*, or *almost all*, the orders of spasmodic diseases, the parts most immediately concerned in ingestion and egestion,—the orifices and exits of the frame,—are those principally affected. The physiology has become pathology. The *larynx* is *closed* in the convulsions of children, in epilepsy, in puerperal convulsion; it is spasmodically affected in tetanus and hydrophobia; it is partially affected in

croup-like convulsion, in hysteria, in which there is frequently loss of voice, &c. The *pharynx* is affected in some of these diseases. The *respiratory muscles* are so in all. In epilepsy we observe affections of the *sphincters*, and even of the ejaculators.

252. No disease can illustrate the pathology of the excito-motory system better than epilepsy. It is sometimes centric and incurable; frequently eccentric, arising from gastric, or intestinal irritations, and curable. It involves every part and every function, of which I have spoken under the head of the physiology. The fourth and sixth nerves are affected, and the eyes move convulsively; the tongue is protruded, the teeth are forcibly closed upon it, the mouth is variously moved, with the extrusion of bloody foam; the larynx is closed, and there are forcible convulsive efforts of the expiratory muscles, and, as I have just stated, the sphincters are sometimes relaxed, and the ejaculators occasionally expel the semen.

253. I must say a few words, in this place, respecting the important function of generation in both sexes.

254. It is plain, from the circumstances, that the act of the *συνουσια* in the male sex is irrespective of the sensation,—one of the true spinal marrow; it is an *excited* act, from an appropriate stimulus. This being wanting, the *act* of ejaculation is as impossible as that of deglutition without saliva, or other appropriate stimulus of the muscles of the pharynx.

255. Gregory, speaking of this act, observes,—"Ita ut totum genus nervosum mirum in modum convellat, musculosque *levatores ani* dictos ad contractionem citat," &c., &c., and adds, "semen in urethram effusum novum dat stimulum cui musculus *accelerator* paret, in reddenda urina voluntarii motus, in expellendo semine invisi motus, organum," &c.

256. The same elegant writer adds,—"Neque solus accelerator musculus convellitur; levis plerumque tremor aut convulsio, aliquando vero vehementissima convulsio omnium musculorum in venere observatur; hinc anhelatio, palpitatio, syncope, *epilepsia* nonnumquam, vel demum subita mors, quæ nonnullos venere occupatos, nec tale quidquam timentes abripuit."

257. I observed, in the paper already mentioned, that there is but a step, as it were, from the normal affection of the nervous, muscular, and respiratory systems, in that circumstance, to an attack of epilepsy of itself; Hippocrates is said to have observed,—*την συνουσιαν ειναι μικραν επιλημψιαν.*

258. On the other hand, there is, in epilepsy, as I have stated, frequently an action of the ejaculatores.

259. The whole of these phenomena lead us to interesting views, both of this act and of this disease. Both are, primarily, affections of the excito-motory system. A patient, mentioned by M. Brachet, perfectly paraplegic, and destitute of all sensation below the loins, becomes a father; the *συνουσια* is described as being "sans sensation, sans secousse." Its influence was *limited* by the disease.

261. With these remarks I must conjoin one or two observations respecting the connection of the uterus with the excito-motory system. Every one is aware of the effect of conception in inducing vomiting, and of the fearful attacks of convulsion which sometimes supervene at a later period of pregnancy, and during, or after, parturition. One patient, on the other hand, subject to epilepsy, lost the attacks during the whole period of pregnancy. The very act of parturition, inscrutable as it is, seems, with abortion, to be one of the excito-motory system.

261. As a final remark, I must mention the singular influence of the *passions* over these and *all* the functions of the excito-motory system. Sickness, panting, convulsions, relaxation of the sphincters; these, and a thousand other affections of this system, are induced, through the mysterious influence of disgust, fear, &c. Infantile convulsions and epilepsy are renewed by vexation, &c.

262. The condition of the larynx and of the respiratory motions, affords an important diagnosis between epilepsy and hysteria. In the former the larynx is usually closed with forcible expiratory efforts; in the latter it is open, with heaving, sighing breathing.

263. In one case of epilepsy my patient, who was musical, lost the power of singing the higher notes after each attack. It is well known how frequent loss of voice is also in hysteria. In hysteria, however, we have rarely, if ever, a bitten tongue.

264. A terrible disease of this order is tetanus. All the symptoms of tetanus sometimes arise from disease within the spine. This ought to be termed *centric* tetanus. Far more frequently the cause is seated externally, in the course of some of the excitor nerves of the system. A nerve included in a ligature, or lacerated in a wound, may prove the *eccentric* seat of tetanus. In both cases it is plain that it is the excito-motory division of the nervous system which is involved in the disease.

265. To show you how little this subject has been understood, I will adduce one fact especially. Even Mr. Swan, than whom few have dissected the nervous system with greater success, imagines that tetanus may have its seat in the ganglionic, or sympathetic system of nerves. Mr. Swan observes,—"I have been induced to inquire how the body is usually affected after accidents. From that inquiry I have been led to state,

that when a severe injury has been received the ganglia of the sympathetic nerves become irritable, and, consequently, the parts to which they distribute nerves." The irritation " may be communicated to many of the cerebral, and all the spinal, nerves, and from these to the spinal chord; thus producing tetanic spasms, spasms varying according to the part of the sympathetic nerve most affected, as well as the extent and complexity of the irritation."

266. It is difficult to conceive how the sympathetic could either be affected by the cause, or produce the symptoms of tetanus; its functions are interstitial, not obvious to our senses, seen only in their *effects*. It is plain, on the contrary, that the real seat of this disease is that portion of the nervous system which I have distinguished from the rest, and designated the excito-motory. Tetanus may be produced at will in the frog, or salamander, by applying strychnine to the skin. If the head be moved the frame is still tetanic. If any portion of the spine,—if even the tail of the salamander be separated, it exhibits all the phenomena of perfect tetanus. These cease on destroying the caudal portion of the spinal marrow, by means of a fine needle. If, in the decapitated turtle, you lay bare certain nerves, and pinch them continuously with the forceps, you immediately induce a state of tonic contraction of the muscles of all the four extremities, and of the tail. This experiment is the very *type* of tetanus, and leaves *no* doubt what particular part of the nervous system is affected in this disease.

267. I have scarcely time so say a word about hydrophobia. But consider how this disease is induced, what symptoms present themselves; what parts, what functions, are involved; and you cannot fail to fix upon the particular division of the nervous system affected in this most terrible of maladies.

268. I must hasten to conclude this lecture. Allow me to say one word respecting vomiting. This act may be excited by disease within the cranium, by irritation of the fifth in the fauces,—of the pneumogastric in the stomach, the gall-duct, the ureter,—of spinal nerves of the cervix uteri. This familiar phenomenon combines the excitor nerves and motor nerves of respiration into one system.

269. On the other hand, dentition produced strangury and tenesmus,—symptoms of calculus,—in the little boy of a friend of mine; symptoms which ceased on freely lancing the gums.

270. In one case, extreme spasmodic stricture of the sphincter ani was produced by the unsuspected presence of a calculus in the urethra. There is no more common event than retention of urine, from passing a ligature round a hæmorrhoid tumour. In all these various cases, an excitor nerve is irritated; the irritation is carried to the medulla oblongata, or spinalis, and reflected upon the muscle, or system of muscles, excited to spasmodic action.

271. The time does not now admit of my adducing more facts of this kind. Before I conclude, however, I must lay before you, some facts of another description.

272. First, disease of the meninges, and of the brain, induce spasmodic actions. How is this explained? I think upon the principles of irritation and counter-pressure. The first *may* act through the medium of the nerves distributed to the membranes, —as the recurrent of the fifth of Arnold. In reference to the second, I may adduce several valuable facts. In an interesting case, most anxiously watched, and accurately detailed to me by my friend, Mr. Toogood, of Bridgewater, of a little girl, aged thirteen months, the croup like convulsion occurred repeatedly, until one day, when the bones of the cranium separated, the convulsion then ceased. In a case of spina-bifida related to me by Mr. Herbert Evans, of Hampstead, there was a croup-like convulsion whenever the little patient turned, so as to press upon the tumour. In the case of anencephalous fœtus, described by Mr. Lawrence, convulsion was produced on pressing on the medulla oblongata. In a case of meningitis given by Dr. Abercrombie, the anterior fontanelle became very prominent; pressure upon it induced convulsion. Hypertrophy of the brain affords an argument of the same kind: it induces convulsion except in the case in which the cranium grows with the encephalon. These and other facts, lead me to think that convulsion arising from cerebral disease is thus to be explained.

273. And now an interesting case presents itself. What is the rationale of convulsion from excessive hæmorrhage? It struck me that this question might be resolved by experiment. I went to a butcher, and begged to see a sheep killed. The usual mode of doing this is, first, to divide the spinal marrow, and then to open the large vessels. At my request, not only the spinal marrow, but the entire neck was divided, the head being separated from the body with the exception of the skin; the blood-vessels were then divided. I watched the effect of the flow of blood. After a certain hæmorrhage had taken place, the animal was violently convulsed. The convulsion could only be *spinal*.

274. One final word upon the pathology of the external portion of the ganglionic system. I think it probable that many of those cases in which *one* limb of an infant ceases to grow, are cases in which the disease is seated in the posterior spinal nerves leading to the part—probably at, or near, their origin. This conjecture must be confirmed by the careful post-mortem examina-

tion of such cases. It may possibly admit of being illustrated by experiment.

275. I beg to observe that I shall, in future lectures, treat of these subjects in their turn, and, as usual, in a perfectly *practical style*, from which the present lecture must be viewed, in some degree, as a deviation.

276. I must conclude this lecture by a few brief remarks upon

IV. The Therapeutics of the Nervous System.

277. Excitement in the cerebral system may be much diminished by a due attention to exclude the patient from light, from noise, from every kind of mental disturbance. To this branch of our subject belongs the whole of the *moral* treatment of the insane, as it has been termed.

278. In reference to the true spinal or excito-motory system, much more may be done.

279. Strychnine obviously excites this system; whilst the hydrocyanic acid as obviously diminishes its powers. These two remedies may, therefore, have appropriate applications. But I have seen them sadly misapplied. What do you think, for instance, of strychnine as a remedy for hydrophobia? Would you not as soon give the hydrocyanic acid in the paralysis of colica pictonum? And is it not preposterous to give the strychnine to excite *spasmodic* affections of one system, the spinal, in order to cure paralysis of another, the cerebral, in hemiplegia, for example?

280. Hydrocyanic acid is the special remedy in certain diseases of the excito-motory system; the exciting *cause* being removed in the crowing inspiration of children, and in asthma, the hydrocyanic acid affords most essential relief; the same thing is true of pertussis, and some other diseases of this class.

281. The carbonate of iron and the liquor arsenici are other remedies, the powers of which are only partially explored. They cure chorea.

282. Then we have an important remedy in electricity and galvanism. Have its powers been *appropriately* applied?

283. Another important remedy, in the class of true spinal affections, is the dashing cold water on the face or surface. This remedy tends to open the larynx in epilepsy, and to convert the violent expiratory struggles into acts of inspiration.

284. Another agent which has great influence upon the excito-motory system is change of air. This is observed in the later stages of pertussis, the croup-like convulsion, &c.

285. Another view of this subject, and a most important one, is the removal of all the *causes* of morbidly excited states of this system. In the convulsions of infants we remove the causes of irritation in the gums, the stomach, the bowels, &c.; and in the epilepsy of adults we adopt similar plans.

286. But I suspect there are many regions uncultivated, unexplored, in this field of investigation. May not counter-irritation be applied more extensively along the spine than hitherto? In a case seen by Mr. Copeland and myself, and already mentioned (§ 132, p. 686) much benefit accrued from the persevering and effectual use of a liniment, consisting of two drachms of liquor potassæ, and of liquor ammoniæ puræ, with twelve of the linimentum saponis. Might not a lotion of the hydrocyanic acid be applied with advantage in some cases of *tonic* spasm?

287. Might not the inhalation of the vapour of this powerful remedy be of service in some spasmodic affections of the respiration, &c.

288. For a further illustration of my views I must refer to the treatment of asphyxia in infants, which will be given in the succeeding lecture. I will close these remarks by observing once more that we have, in this part of the subject, much still to investigate, especially in the way of experiment.

289. I have thus conducted you through the general principles of the nervous system, and we are now prepared to take up the individual diseases of that system. But before we proceed to these, it may be well for me to recapitulate what has been done by my own investigations. I have shown you then,—

I. That the vis nervosa of Haller obeys other and different *laws* from those laid down by that eminent physiologist, and by Professor Müller.

II. That this same power is the active but *unsuspected* agent in the experiments of Redi, Whytt, Legallois, Mr. Mayo, &c.

III. That this same power has a most extensive but *unsuspected* application to *Physiology*, *Pathology* and *Therapeutics*; and

IV. That it reposes in a special and *unsuspected Anatomy*, consisting of

1. *The True Spinal Marrow*, with
2. *Incident*, *Excitor*, and
3. *Reflex*, *Motor Nerves*.

These constitute the *True Spinal Excito-Motory System*, the importance and extent of which no one yet knows. *These constitute my discovery.*

More or *less* than these I do not claim.

I find I have made a mistake in § 7, p. 649. I have there stated that Mr. Mayo was the familiar pupil of Sir Charles Bell. Mr. Mayo's intimacy with Sir Charles Bell terminated in 1815. Both Sir Charles Bell and Mr. Mayo's inquiries were posterior to that date, and independent of each other.

As my sole objects are truth and justice I have great pleasure in subjoining this.

P.S. In a "History of the Nervous System," which I am preparing for publication I shall not fail to do strict justice to all parties.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From The Lancet, February 24, 1838.]

Lecture V.

The Nervous System.—*Action of Strychnine in paralysis.* Congenital States of the Nervous System.—*Complete absence of the nervous centres. Description of anencephalous fœtuses. Explanation of the phenomena observed in them. M. Lallemand's observations.* Congenital Diseases of the Nervous System.—*Asphyxia and its treatment. Remedies must be directed to the excito-motory nerves. Secondary asphyxia. Encephalitis and tubercular hydrocephalus. Early symptoms. Morbid anatomy. Treatment.*

Gentlemen:—Before I proceed to the proper object of the present lecture, I must beg your attention to a fact connected with the *therapeutics* of the excito-motory system. It has been observed that if *strychnine* be given in cases of *paralysis*, the paralytic limbs experience its peculiar effects *before* the healthy limbs. What is the rationale of this phenomenon?

290. It occurred to me that the irritability of the muscular fibre might be greater in the inactive than in the active limb, and that the strychnine acting *equally* through the true spinal system, would produce most marked effects upon the most irritable muscles. But facts were wanting to establish the first fact, viz., that the irritability of the muscles of the paralytic limb was really greater than that of the healthy and active one; for Nysten had only shown that the irritability of a paralytic limb was not impaired—was not less than that of a healthy limb. (*Rech. de Phys.*, page 377). This proof was afforded me by a most interesting case. A little child, aged ten years, was *perfectly* parnlytic of the *left* arm. Amongst other remedies, I prescribed galvanism. My young friend, and very intelligent pupil, Mr. Dolman, undertook to apply it. I directed him to apply the *slightest* shock which would produce an obvious effect, and mark in which limb it first occurred. He did so, and uniformly observed that the paralytic limb was agitated by a degree of galvanic energy which produced *no* effect on the healthy limb. Thus my conjecture was proved to be perfectly just. I believe the fact will not be without its interest to physiologists.

291. I must recall to your minds, in connection with this subject, the effects of emotion on the paralytic arm, in the case of hemiplegia (see § 203), and the *contracted* condition of the limb long affected with paralysis,—the effect of the excito-motory principle of *tone* on muscles of augmented irritability (see § 19, &c., and Memoirs, p. 101, &c.). The contraction of the limbs in persons born with atrophy of the brain, and consequently paralytic, and in cases of old hemiplegia, doubtless depends upon the constant influence of the true spinal marrow, or the principle of tone, on muscles whose irritability is great from want of voluntary actions.

292. I now proceed to the proper subjects of this lecture, viz.:—

The Congenital State of the Nervous System; Asphyxia, its Remedies, &c.

The condition of the fœtus in utero, is that of a merely true-spinal, or excito-motory and ganglionic existence. Nay, in many instances of imperfect formation, not only the cerebral, but the true spinal system, is undeveloped. There is, in fact, no degree in which imperfection of the nervous system may not exist in the fœtus in utero.

293. There may be complete absence both of the spinal marrow and of the encephalon, in which case the fœtus is termed *amyelous*, or *amyelencephalous*. There may be the absence of the encephalon,—of the cerebrum and cerebellum only; in this case the fœtus is designated *anencephalous*. Or the cerebrum merely may be in a state of defective

development, or of *atrophy*, more or less partial or extensive.

291. The amyelous fœtus cannot survive the moment of birth. The anencephalous fœtus may support an extra-uterine life for several hours, displaying the interesting spectacle of the phenomena of the true spinal or excito-motory system, exclusively, in the human subject; but these phenomena gradually cease, or, in other terms, the anencephalous fœtus is not *viable*, the influence of the brain being required, in addition to that of the spinal marrow, for the continuance of life. In the case of atrophy, the fœtus is viable, and may survive for years, but in a more or less idiotic, or paralytic condition; that is, with greater or less defect of the sentient and voluntary functions, according to the degree of atrophy or defect of the encephalon.

I need not adduce any examples of the amyelous *fœtus*, which is always anencephalous too, and generally affected with spina bifida. It affords no illustration of events which occur in extra-uterine life,—or disease.

295. Of the anencephalous fœtus we have most interesting accounts by Mr. Lawrence, M. Lallemand, M. Ollivier, &c.

The description of the phenomena presented in such a case, witnessed and recorded by Mr. Lawrence, is as follows:—"The child moved briskly at first, but remained quiet afterwards, except when the tumour was pressed, which occasioned general convulsions. It breathed naturally, and was not observed to be deficient in warmth, until its powers declined. I regret that from a fear of alarming the mother, no attempt was made to see whether it would take the breast; a little food was given it by the hand. It voided urine twice in the first day, and once a day afterwards; it had three dark-colored evacuations. The medulla spinalis was continued for about an inch above the foramen magnum, swelling into a small bulb, which formed the soft tumour on the basis of the skull. All the nerves, from the fifth to the ninth, were connected to this." This brief detail is full of interest. The respiration was natural, the medulla oblongata being entire. Swallowing was effected when the food was brought into contact with the pharynx; the sphincters performed their functions; the limbs were moved when the skin was first impressed by the atmospheric air. There was no indication of sensation—the child remained quiet after the first brisk movements, and no event is mentioned which could establish the existence of voluntary motion,—the acts of swallowing, and the expulsion of the urine and fæces, with the functions of the larynx and of the sphincters belonging distinctly to the excito-motory system.

296. The description of an anencephalous fœtus, given by M. Lallemand, is equally interesting:—"Four years ago, I saw at the *Hôtel-Dieu*, an anencephalous fœtus, born at the full period, or nearly so, which lived three days. It cried pretty strongly, exercised the movements of sucking every time that it felt something between its lips; but they were obliged to feed it with milk and sugared water, because no nurse would give it the breast. It moved freely the thoracic and abdominal muscles. When a foreign body was placed in its hands, it bent its fingers as if to seize it; but, in general, all its movements had less energy than those of a fœtus of the same age.

"The cerebrum and cerebellum were entirely wanting; only the medulla oblongata and the tuber annulare remained at the base of the skull, with the origin of the pneumogastric, trifacial, and optic nerves. The whole was covered by the remains of the bones of the skull, of the membranes, and of the skin."

A similar case is detailed by M. Ollivier, who remarks:—"I observed an anencephalous infant two hours after its birth. The eyes were constantly shut; its cries, which were frequent, were easily quieted by introducing the finger into its mouth; it then exercised repeated sucking movements; it moved its limbs with tolerable strength, and pressed between its fingers any substance placed in its hands.

"I again saw it at the end of three hours. The feet and hands were become purple and cold, the respiration was less frequent; the movements of the spinal marrow, which I had at first remarked, still continued to take place, and followed each of the deep and long inspirations which it made. The cries were less strong and less frequent; they gave it, at intervals, small spoonfuls of old sweet wine.

"Insensibly the coldness of the extremities reached the limbs and the body; respiration continued at longer intervals; it became convulsive. This state continued for six or eight hours; its cries became more feeble and less frequent, like the respiratory movements, which were accompanied with general convulsions, and it died perfectly asphyxiated, after having uttered a cry analogous to that which results from hiccough."

M. Ollivier adds:—"In this case there did not exist a single rudiment of the encephalon and of the prolongations of the medulla oblongata; the spinal marrow alone was perfect, and yet this infant performed repeated movements of suction, and forcibly squeezed substances placed in its hand; these movements were far from being automatic, like those which agitated the inferior limbs."

297. These cases, in connection with the preceding one are full of interest. The peculiar cries which resemble, in their rationale, the croup-like convulsion from dentition; the closed state of the eyelids; the

action of suction excited by the contact of the finger; the closure of the fingers excited by objects placed in the palm of the hand, and the movements of the inferior extremities, in this acephalous infant, are phenomena of the excito-motory system, of the most deeply interesting character.

298. The following facts are extracted from a letter addressed by Mr. Sweatman to Sir Charles Bell, and published in the "Nervous System." In a case of parturition, "after the membranes had given way, and the liquor amnii had escaped, the midwife, on examining, found another membranous bag presenting, which she naturally supposed belonged to a second child, and therefore did not interfere. During the passage of the bag under the os pubis, it suddenly burst, and the whole of the brain escaped from the opening, very much smashed, and hanging together only by its membranes. The child breathed with perfect freedom, and cried strongly, rolling its eyes about in a wild staring manner. It moved its lower extremities freely, and that not from spasm, but obviously in obedience to external impressions. There was no motion whatever of the upper extremities.

"In this state it remained for about three hours, when all motion in the extremities ceased, the eyes became fixed, and the breath gradually slower, till it ceased altogether, just seven hours after the birth of the child. During this time neither urine nor meconium passed, nor had there been any hæmorrhage from the vessels of the brain.

"On examinntion, the occipital bone and the posterior part of several of the cervical vertebræ were found wanting, and their place had been occupied by fluid surrounded by a membranous bag: an instance of spina bifida of the neck. The spinal marrow was perfect.

"A somewhat similar case occurred to me about three years ago, when I had occasion, from peculiar circumstances, to remove the brain of a child through the anterior fontanelle. In that instance about ten minutes elapsed before its birth, yet it drew a deep inspiration, and would have cried had it not been prevented; and the motions of the *lower* extremities continued about half an hour, although the whole of the brain had been removed, and a blunt instrument repeatedly thrust down the foramen magnum."

299. Such are a few of the facts which prove the presence of a system of excito-motory functions attached to the medulla spinalis, and existing independently of the brain, in the human subject. The excited acts of suction on stimulating the lips; of deglutition, on stimulating the pharynx; of the closure of the hand, on stimulating the palm; of the lower extremities. "*obviously in obedience to external impressions*," are all phenomena of the deepest interest, as illustrations of this system.

M. Lallemand, who has attended most to this subject, still considers these motions to arise from *sensation*, and yet, singularly enough, considers the *volition* as suspended.

300. It is impossible to conceive a greater confusion of all ideas on this physiological question, than is presented in the following paragraph, which I quote from this author, and several parts of which I mark with particular emphasis: — "The instinctive automatic movements produced directly by sensations, without the medium of reflexion, or of volition, are observed at all periods of life; during sleep they preside over respiration, replace the deranged bed-clothes, push aside those which are too warm; shrink from a puncture, tickling, or external pressure, or change the position; (!) *the whole* without the least consciousness on the part of the brain." (!) I could not address a more lively proof of the necessity of reconsideration of this subject.

301. What are the movements produced immediately by sensation? There can be no such thing. How can sensation act in inducing motion, except through the medium of volition? It is impossible. And who can confound the *excited* motions of respiration, with the *voluntary* act of replacing a coverlet?

302. There is another remark of M. Lallemand, of which I am compelled to say that it is equally unfounded:—"This immediate influence of the spinal marrow on the nerves which go to it and from it, becomes gradually weaker as that of the brain diminishes, but it never disappears altogether." The truth is, that the intellectual functions are daily developed during the first years of life, and *obscure* those of the excito-motory; but the latter are not *enfeebled* during this change, which is one of *superaddition*, not of *substitution*.

303. The account of the phenomena presented by the anencephalous infant, during the few hours of its extra-uterine life, drawn up by one well imbued with the distinction of the functions of the cerebral, or sentient and voluntary, and the true spinal, excito-motory systems, would possess the deepest interest to the physiologist and pathologist.

304. In the cases of atrophy of the cerebrum, sensation, intellect, and voluntary motion, are *superadded* according to the degree of development of the brain. But, in general, there are *sensibility*, *idiocy*, and *paralysis*; and, as the cerebrum is frequently more atrophied on one side than the other, there is usually some *hemiplegic* lameness of the opposite side of the body. There are frequently epileptic attacks, or contractions of the limbs.

305. M. Lallemand observes, that when the superior and inferior extremities are un-

equally affected, the former are always more paralysed or contracted than the latter; and that, whenever the paralysis is not complete, the sensibility is less affected than the movements.

306. Upon this last point I find it necessary, however, to recur to the want of distinction on M. Lallemand's part, between the movements which result from sensation and volition, and those which belong to the excito-motory system; I shall, at the same time, again point out the absolute necessity for attention to this distinction. M. Lallemand observes:—"It is not rational to expect, as has been done, in a given part of the encephalon, one organ for the perception of sensations, and another for the determination of voluntary movements." —"This question is decided by the examples which I have just quoted of fœtuses deprived of cerebellum, which nevertheless experienced distinct sensations, and reacted upon these sensations in a manner sufficiently regular to grasp a body placed in the hand, to seize the breast of its mother with its lips, and to exercise the action of suction and deglutition."

307. It is plain, from this quotation, that the want of the distinction on which I am insisting must prove a continual barrier to the progress of physiology, and consequently of pathology.

308. The sensibility must be studied in the senses of smell, sight, hearing, taste, and touch, distinguishing this last carefully from excitation. The intellect must be studied in the physiognomy, the gestures, the voice, and articulation, in the alternations of sleep and waking; in the susceptibility of attention to bright objects, toys, amusements, &c.; the voluntary movements in examples unequivocally distinct from the excito-motory phenomena.

309. In every case of a viable infant I suppose the excito-motory functions will be complete.

The external ganglionic subdivision of the nervous system must be carefully examined in every instance of *partial development*, as of an organ, a limb, &c.

310. I shall close these remarks by a few observations upon *congenital* diseases of the nervous system. They may be divided into those which take place *in utero*, and those which are induced *inter partum*.

311. The former are, principally, defective development, or atrophy, or destruction of the encephalon or spinal marrow; hydrocephalus and hydrorachitis, or spina bifida.

The latter are apoplexy and asphyxia.

Of the former class I shall not say more at this moment.

Of the whole number of *still-born* children at the *Maternité* of Paris, M. Cruveilhier says that one-third are affected with *apoplexy*. The *cause* of this affection is most probably the violence inflicted during severe labour. The *form* is *meningeal*; that is, diffused coagula of blood are found between the membranes, especially at the posterior part of the encephalon, and in the ventricles, without rupture of the *substance* of the brain. The symptoms are not to be distinguished from those of feebleness and asphyxia; some infants have lived with these symptoms for one, two, three, or four days; and some may even have recovered altogether. The *prevention* obviously consists in cautiously accelerated delivery; the *treatment* cannot, until the diagnosis is made evident, be distinguished from that of asphyxia.

312. To *asphyxia* I will now draw your attention in a particular manner. *Its* prevention and treatment are constantly points of the utmost anxiety to us.

313. The infant is said to be *still-born*. You wait for the establishment of respiration, and this event does not take place. There is a general alarm. You will now, for the first time, see the value and importance, in a *practical* point of view of the principles of the physiology and pathology of the nervous system which I have been teaching you. I have told you that *respiration* is an *excited* function; that it belongs to the excito-motory subdivision.

314. In one word, then, all our efforts must be instantly made to *excite* respiration. Now, what are the channels through which this act may be excited? What are the excitors of respiration? The *fifth*, the *pneumogastric*, and the *spinal* nerves.

315. The *fifth* pair of nerves must be excited by *forcibly* blowing, or dashing cold water on the face,—by stimulating the nostrils by ammonia, snuff, pepper, or the point of a needle.

316. The *spinal* nerves must be excited by *forcibly* dashing cold water on the thorax, the thighs; by tickling, or stimulating the sides, the soles of the feet, the verge of the anus.

317. What the pneumogastric is, as the excitory nerve of respiration, under ordinary circumstances, the fifth and the spinal nerves are, in cases of asphyxia, or suspended respiration. The means recommended for exciting respiration through these excitors frequently induce a sudden act of inspiration, which proves the first series, so essential to animal life.

318. But if these attempts to *excite* respiration through the fifth and spinal nerves fail, we must *imitate* this function, by artificially distending the lungs, in the hope that, eventually, it may be excited through its wonted channel, the *pneumogastric*.

319. To effect this, the practitioner's lips are to be applied to those of the infant, interposing a fold of linen, and he is to propel

the air from his own chest, slowly and gradually into that of the infant, closing its nostrils, and gently pressing the trachea on the œsophagus. The chest is then to be pressed, to induce a full expiration, and allowed to expand, so as, if possible, to effect a degree of inspiration.

320. But it is important, in doing this, that the practitioner himself should previously make *several deep* and rapid respirations, and, finally, a full inspiration. In this manner the air expelled from his lungs into those of the little patient, will contain more oxygen, and less carbonic acid, and consequently be more capable of exciting the dying embers of life.

321. I base this suggestion on an interesting communication by Dr. Faraday, in the "London and Edinburgh Philosophical Magazine," vol. iii., p. 241, for October, 1833, to which I have already referred. It is ascertained that respiration may be suspended longer, as in diving, or in experiments, after such repeated forced respirations, than in ordinary circumstances, from the greater purity of the air in the lungs.

322. If all these plans should be tried in vain, I would strongly advise galvanic or electric shocks, to be passed from the side of the neck to the pit of the stomach, or in the course of any of the *motor respiratory* nerves, and their appropriate muscles. No time should be lost in sending for a proper apparatus; but, should the lapse of an hour, or even more, take place before it *can* be obtained, still it should be sent for and tried.

323. When respiration is established, the *face* must *still* be freely exposed to the air, whilst the temperature of the limbs and body is carefully sustained.

324. In the *midst* of these efforts it should, in the next place, be the office of two other individuals, to maintain or restore the *temperature* of the little infant, by gently but constantly pressing and rubbing its limbs between their warm hands, passing them upwards, in the direction of the venous circulation.

An enema of gruel, at 98°, or 100°, or *higher*, with a little brandy, should be administered.

325. As soon as possible a little warm liquid, as barley-water, at blood-heat, should be given by means of the proper bottle, furnished with leather, or soft parchment. A teaspoon must not be used for fear of choking. If the infant draws the liquid through its own lips, by its own efforts, there is no danger.

326. Lastly, these various means should be continued or repeated in the most persevering manner.

When an infant has been restored from a state of asphyxia; it frequently relapses into a *secondary asphyxia*, and is lost.

327. This is a general fact in regard to asphyxia. I put a bird and a mouse into the same bell-glass, inverted over water. First, the bird, and eventually the mouse, began to gasp. I put them into their respective cages. The bird was dead the next day, and the mouse on the succeeding day.

328. Sir Humphrey Davy experienced a secondary attack after breathing hydro-carbonate. A corporal of the Guards, upon being apparently restored from asphyxia from submersion, was affected with convulsions, and expired.

In a case of asphyxia from laryngitis, after the patient had ceased to breathe, the trachea was opened, artificial respiration was performed, and re-animation took place, but the patient expired shortly afterwards.

329. These facts should keep us upon our guard against secondary asphyxia; we should watch our patient, and be prepared with all our remedies; we should dash cold water on the face occasionally, and expose the face of the patient to the cool, free, open air; and we should enjoin, in an adult, frequent, full respirations.

330. How interesting would be a series of well-conducted *experiments* upon young animals, with the view of ascertaining, by comparative trials, the degree of efficacy of the various remedies for *asphyxia*. I have sometimes thought that, if one wire of the galvanic apparatus were properly inserted into the nostril, and the other within the sphincter ani, the shock might have great efficacy.

331. I cannot conclude the subject of congenital diseases of the nervous system, better than by giving the following interesting case, already noticed, for which I am indebted to Mr. Herbert Evans:—

"On the 2nd November, 1832, I attended, in labour, the wife of a poor man, who was a plumber, and who, for some time, had been the subject of epileptic attacks. The mother was diminutive and weakly. Whilst the nurse was washing the child, I observed that there was a tumour on the loins, about the size and form of half a French walnut; on examining it, this was found evidently to arise from hydro-rachitis. In a short time the tumour lost its shrivelled state, and became distended into a semi-round bag. The child being pretty strong, I resolved to treat the disease by pressure; when, on compressing it slightly, previously to applying a bandage, I was surprised to find that such pressure was immediately followed by the affection described by Dr J. Clarke. Whenever the pressure was applied, a similar effect resulted, and the nurse was obliged to be very careful in laying the child down, not to allow the swelling to bear any part of the weight of the body; if she did, the severity of the spasm was such as to threaten suffocation.

"The tumour became daily more prominent, and its sides thinner, until, after about two months, it appeared as if it would give way. It seemed better now to evacuate the fluid gradually, rather than allow it to burst; accordingly, a small opening was made with a needle, and the fluid, which was limpid, oozed out constantly, without any apparent effect. The child lived until the end of February, when it sank, without any definite complaint.

"The examination of the body presented nothing deserving of attention.

"The name, *chronic croup*, given by some authors, is surely most unfortunate; it is often by no means chronic, and has no relation whatever to croup. It is evidently a convulsion of the respiratory muscles, and in many respects seems to have an analogy with hooping-cough; for instance, the similarity of the hoop, and the tendency of both to pass into general convulsions, death, &c. The above case seems to throw some light upon its nature, inasmuch as it proves that pressure upon the nervous centres (perhaps the medulla oblongata) may, under certain circumstances, produce it."—Dec. 15, 1834.

332. I now proceed to treat of several of the diseases of the nervous system in infants, and first

Of Encephalitis and Tuberculous Hydrocephalus.

I shall have occasion again to draw your attention to my subdivision of the nervous system, into the sentient and voluntary, the excito-motory, and the ganglionic; for the diseases of which I am about to treat, *begin* in the first, and *proceed* to involve the second, and the last *in their course*.

You will now perceive the intrinsic and *practical* importance of these divisions.

I must proceed to state, that the *cerebral* diseases of infants may be divided into—

1. *Encephalitis.*
2. *Tuberculous Hydrocephalus.*
3. *Hydrocephaloid Diseases.*
   - *a. From Intestinal Disorder.*
   - *b. From Exhaustion.*

Encephalitis is only to be distinguished from the tuberculous hydrocephalus:—1. By our being able to trace it to some external cause, as a *fall*, or *blow*, too frequently concealed by the nurse at the time of its occurrence. 2. By ascertaining the *absence* of hereditary *predisposition*. 3. By its acuter symptoms, course, &c.

Important as the distinction is, therefore, in reference both to the prognosis and treatment, I am compelled to combine the description of these two diseases, pressing upon you the absolute necessity of a strict inquiry into the two points which I have just mentioned.

333. The *earliest* symptoms of encephalitis and of tuberculous hydrocephalus are, then, those which relate to the *cerebral* functions, which are *exalted*. These functions are so slightly developed in infants, that their state of exaltation too frequently passes unnoticed. Yet the phenomena are obvious enough, if there be but a careful observation on the part of the parent, or nurse, on whom the duty of noticing the *dawn* of these diseases must devolve.

334. The *first* symptom is an unhappy countenance and manner, a general expression of pain, of suffering, or, at least, of uneasiness; the brows are contracted on exposure to light, on being moved or disturbed; the temper is fretful in the same circumstances; the head is, perhaps, moved to and fro continually. The infant is only quiet when left in a state of undisturbed repose. Sometimes there is a perpetual moaning, or whining, sometimes a piercing cry.

335. In the *next* place I must mention the state of *the sleep*. This is broken; and although the little patient is only quiet when let alone during the day, yet its nights are disturbed by restlessness, or starting and crying. There is in the midst of all this a peculiar stupor.

336. There is intolerance of light and of sound. The eyelids are forcibly closed, the pupils contracted, on approaching the window, or a bright light; any sudden noise induces starting, alarm, crying, &c. The skin is, also, frequently very sensitive to the contact of the fingers of the medical practitioner, as we ascertain on feeling the pulse, &c.

337. It is in vain to speak of *delirium*, for how is this to be manifested in an infant? However, restlessness takes its place, and constitutes an important symptom; and frequently a deceitful sardonic smile plays upon the countenance, or an expression of fear, or fright, is written there.

338. Unfortunately these symptoms, although observable enough, usually meet with some hypothesis in the minds of the parent and nurse, and are referred to the stomach and bowels, &c., &c., and much valuable time is usually lost.

339. To the observant physician they speak another language. A contracted brow and a contracted pupil, with want of sleep at night, and want of quiet in the day, must never be overlooked.

340. Such are the true *cerebral* symptoms; but these are frequently allowed to proceed until some far more formidable symptom, belonging to the *excito-motory* system, supervenes. The *most frequent*, and the least formidable in appearance, amongst this second series of symptoms, is *vomiting*. Never, never, allow vomiting in an infant to pass without paying the utmost attention, and making the strictest inquiry, in reference to the functions of the brain. It is

frequently the *first* symptom *noticed* of encephalitis, or hydrocephalus.

341. The next symptom belonging to the excito-motory division of the nervous system is *strabismus*, a *contracted* state of the muscles of the *thumb* or *fingers*, or some unequivocal *spasmodic* or *convulsive* affection of the *respiratory* muscles, or of the muscles of the *limbs*. No one *can* see the least of these things without the most extreme alarm.

342. These symptoms, from being apparently slight and transitory, become continuous and severe; the eye is affected with strabismus, or is turned obliquely upwards, by the *tonic* action of the abducens, or the pathetic; or there is a rocking, or rotatory motion of the eye, by the clonic action of the same nerves and muscles; the thumb is drawn spasmodically into the palm of the hand, and the fingers are closed over it; the toes are contracted towards the sole of the foot, and the arms are frequently affected with rigidity. There are *fits*, with spasmodic croupy inspirations, from contraction of the glottis and action of the muscles of inspiration, or there are general *convulsions*.

343. The bowels are obstinately constipated.

These two series of cerebral and true spinal symptoms mark two distinct degrees of violence of this terrible malady.

344. The third stage is denoted by coma, and its concomitant diminution of the faculties of the sentient and voluntary system, and eventually of the powers of the excito-motory system.

345. There are blindness, deafness, deep stupor, the absence of voluntary motions. At the first, the eyelids are constantly half-closed, but *still* close completely on touching the eyelash; afterwards this excito-motory phenomenon ceases; the respiration becomes irregular, alternately *suspended*, *sighing*, and, at length, stertorous; the sphincters lose their power, and the fæces and urine are passed unconsciously.

346. The countenance is, alternately, slightly pale and slightly flushed at the first; afterwards it is pale and emaciated.

The general surface is, like the countenance, cool, shrunk, and emaciated, in the later periods of the disease.

347. The pulse, which is slow at the first, becomes gradually more and more frequent and feeble, until, towards the close of the disease, it is counted with difficulty.

The tongue is white and loaded. The secretions are morbid; the alvine evacutions dark-coloured and fœtid.

348. How interesting and valuable would a series of cases be taken in the rigid spirit of truth, and of the divisions of the nervous system into the cerebral, the true spinal, and ganglionic.

349. The morbid anatomy of encephalitis consists in the effusion of serum and of lymph under the arachnoid, and of serum into the ventricles, and in softening of some part of the cerebral mass. Of the latter change I saw an interesting case a short time ago in a child of two years of age.

350. The morbid anatomy of tuberculous hydrocephalus consists of the effusion of serum into the ventricles, and under the arachnoid at the summit, but especially at the base of the brain. M. Rufz has recently called the attention of the profession to peculiar, white, semi-transparent granulations, formed in the arachnoid, especially at the base of the brain. Tubercles occurred in the cerebrum or cerebellum in thirteen cases out of twenty-seven, in which these granulations were observed by M. Rufz. The spinal marrow and its membranes examined in twelve cases were found free from morbid change.

351. The connection between hydrocephalus and strumous affections has long been noticed. M. Rufz, in his interesting Thesis, states, that tubercles of the lungs occurred in *every* case examined after their frequent coincidence with hydrocephalus had been distinctly ascertained. Granulations were observed in other organs, the lungs, the pleura, the peritoneum, the liver, the kidneys.

352. The treatment of encephalitis and of hydrocephalus, in the *early* stage, and especially of encephalitis, must be energetically antiphlogistic.

353. Bloodletting, general and local, must be adopted in its fullest measure. The child should be placed in the perfectly erect position, and the jugular vein should be opened, and the blood be allowed to flow until the lips turn pale; afterwards, venesection, cupping, or leeches, should be employed and repeated, according to the age and strength of the little patient, and the period and violence of the disease.

354. The bowels should be freely purged. The system should be brought under the influence of mercury as promptly as possible, by means of calomel, or the hydrargyrum cum cretâ, and the unguentum hydrargyri.

355. The head should be kept high, and bathed with a spirit lotion, or covered with a bladder, partly filled with pounded ice. The feet should be fomented with hot water frequently, and kept warm. The diet should consist of barley-water. Every source of excitement or of disturbance should be carefully removed.

356. Later in the disease counter-irritation by blisters applied to the head, or the neck, mercury, a more nutritious diet, and continued fomentations of the feet, may be tried.

357. I must not dismiss the subject of encephalitis and of hydrocephalus without reminding you of the comatose and convulsive affections which occasionally supervene on acute anasarca, especially that which follows scarlatina in children. The most

prompt and energetic use of the lancet is the only remedy in this case.

In my next lecture I shall proceed to treat of *two* of the most important and most interesting cases of *infantile* disease: the first is the *hydrocephaloid* disease; the second, the *croup-like* disease. Both are *terrific* in appearance, and in reality if mistreated; but both are safely curable if understood, and if treated by proper remedies. I believe that both have been first clearly illustrated by my own researches.

In every step we take in reference to hydrocephalus, and the hydrocephaloid and the croup-like diseases, we have continually to advert to the distinctions into the cerebral and true spinal systems. It is impossible otherwise to *interpret* the symptoms.

In concluding this lecture, I beg to call your attention to one of the most valuable Essays upon Hydrocephalus hitherto published. It will be found in THE LANCET for 1835-6, vol. ii., p. 232 It is written by the pen of Dr. Green, and in the spirit of the most accurate physician of the age, M. Louis.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, March 10th, 1838.]

LECTURE VI.

THE HYDROCEPHALOID DISEASE.

HYDROCEPHALOID DISEASE.—*History of its discovery; its causes, stages; symptoms of each stage; illustrative cases; treatment. Observations of Dr. Abercrombie and Dr. Gooch. Cases by Drs. Heming and Tweedie. Dr. Gooch's history of the disease.* THE CROUP-LIKE DISEASE.—*Errors of Drs. Clarke and Ley respecting its origin; it is explained by reference to the excito-motory nerves.*

GENTLEMEN:—I now beg your attention to two important diseases of childreu:—the *hydrocephaloid*, and the *croup-like*, diseases. They are of every-day occurrence in practice; they have *both* been viewed as hydrocephalus; and they are curable or fatal, according as our diagnosis and treatment are just or erroneous.

358. I first gave a sketch of the hydrocephaloid disease in a little volume of "Medical Essays," published in 1825, but now out of print. It has since been briefly noticed by Dr. Abercrombie, in his valuable "Researches on Diseases of the Brain and Spinal Chord," published in 1828. I read an Essay upon it at the *Medico-Chirurgical Society*, on the 9th of December, 1828. Lastly, Dr. Gooch has treated of this affection in his excellent "Account of some Diseases peculiar to Women," published in 1829. These are all the notices I have hitherto seen of this singular and interesting disorder.

359. The credit of having first distinguished this disease from hydrocephalus, has been given to Dr. Abercrombie and Dr. Gooch. These dates will, however, settle the questions both of priority and originality.

360. The hydrocephaloid disease depends principally upon exhaustion. This exhaustion has its origin in early infancy, chiefly in diarrhœa, or catharsis, in the later periods of infancy, in the loss of blood, with or without the relaxed or evacuated condition of the bowels. The state of diarrhœa has generally depended upon improper food, or intestinal irritation. It has very frequently succeeded to weaning, or to other changes in the diet, or to constipation. The catharsis has followed the administration of an aperient medicine, which, at such a moment of disorder of the stomach and bowels, is apt to act excessively. The exhaustion from loss of blood generally follows the inappropriate or undue application of leeches, or the use of the lancet.

361. I may observe, indeed, in this place, that of the whole number of fatal cases of disease in infancy, a great proportion occur from this inappropriate or undue application of exhausting remedies. This observation may have a salutary effect in checking the ardour of many young practitioners, who are apt to think that if they have only bled, and purged, and given calomel enough, they have done their duty; when, in fact, in subduing a former, they have excited a new disease, which they have not understood, and which has led to the fatal result.

362. This question, and that of the effects of exhaustion in infants and children, open a new field of investigation. Almost all our works on infantile diseases are silent on the subject; and yet without an accurate knowledge of it, I regard it as totally impossible that we should be prepared to watch and treat the morbid affections of this young and tender age. The subject must be taken up and investigated anew. All the affections which may arise from exhaustion, must be accurately observed, distinguished from similar affections arising from a variety of other causes, and traced back to their origin, and forward in relation to their remedies. In this manner some *hydrocephaloid*, *convulsive*, and even *croupy* affections will be viewed in a new aspect; and we shall be

preserved from some painful dilemmas into which we should assuredly fall without this knowledge of the effects of exhaustion.

363. This affection may be divided into two stages: the first, that of irritability; the second that of torpor. In the former there appears to be a feeble attempt at reaction; in the latter the powers appear to be more prostrate. These two stages resemble in many of their symptoms, the first and second stages of hydrocephalus respectively.

364. In the first stage the infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched, or from any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered.

365. If, through an erroneous notion as to the nature of this affection, nourishment and cordials be not given, or if the diarrhœa continue, either spontaneously, or from the administration of medicine, the exhaustion which ensues is apt to lead to a very different train of symptoms. The countenance becomes pale, and the cheeks cool or cold; the eyelids are half closed, the eyes are unfixed, and unattracted by any object placed before them, the pupils unmoved on the approach of light; the breathing, from being quick, becomes irregular and affected by sighs; the voice becomes husky, and there is sometimes a husky, teasing, cough; and, eventually, if the strength of the little patient continue to decline, there is crepitus or rattling in the breathing; the evacuations are usually green; the feet are apt to be cold.

366. A similar train of symptoms occurs in other cases, in which the strength of the little patient has been subdued, and the vascular system exhausted by the abstraction of blood. In both cases leeches are sometimes again applied to subdue this new form of disease, under the erroneous notion of a primary cerebral affection. This measure infallibly plunges the little patient into imminent, if not irretrievable danger. Sometimes the sinking state goes on in spite of every appropriate remedy. Stimuli, if efficacious, reduce the frequency of the pulse, and restore the wonted warmth, colour, expression, and smiles to the countenance.

367. The condition of the cheeks, in regard to colour and warmth, may be considered as the pulse of very young infants, indicating the degree of remaining power, or of exhaustion. In the present case, especially, there is no symptom so important, so distinctive. It is from the condition of the cheeks, in conjunction with a due consideration of the *history*, that the diagnosis of this morbid state, and the indication of the appropriate remedies, are chiefly to be deduced. The general surface, and especially the hands and feet, also afford important sources of information as to the condition of the nervous or vital powers. Next to these, the degree of frequency of the pulse, and the character of the breathing, are points of the greatest importance; during the stage of irritability, the breathing is quick; during that of torpor, it is slower, irregular, suspirious, and, finally, crepitous; the pulse changes in its beat, from being full becoming smaller, but retaining, perhaps, its former frequency.

368. We should be especially upon our guard, not to mistake the stupor, or coma, into which the state of irritability is apt to subside, for the natural sleep, and for an indication of returning health. The pallor and coldness of the cheeks, the half-closed eyelid, and the irregular breathing, will sufficiently distinguish the two cases.

369. This brief sketch of the symptoms, in this interesting infantile affection, is taken from an essay published upon the subject some years ago. I have recently had a most interesting opportunity of observing the symptoms in an extreme case, although followed by perfect recovery.

370. The patient, a little boy, aged 4, became comatose, and perfectly blind and deaf. The finger might approach the half-closed eye, without inducing any movement; but the moment it touched the eyelash, the eyelids closed. A spoon applied to the lips excited their action, and the fluid it contained was conveyed into the pharynx and swallowed. The respiration was frequently suspended; a sigh and frequent respiration followed. The cerebral functions had ceased; the true spinal functions remained.

371. In another case of a little girl, one year old, the eyelids ceased to close, even when the eyelash or the eyeball was touched. Yet recovery took place under the prompt and efficient exhibition of stimuli.

372. The remedies for this morbid affection, are such as will check the diarrhœa, and afterwards regulate the bowels, and restore and sustain the strength of the little patient. With the first objects, it may be necessary to give the tinctura opii, and chalk, and, afterwards, the pilula hydrargyri, rhubarb, and magnesia; with the second, sal volatile, but especially brandy, and proper nourishment, are to be given according to circumstances. But in this, as in many cases of infantile disorders, the milk of a young and healthy nurse, is the remedy of most importance, in the absence of which ass's milk may be tried, but certainly not with the same confident hope of benefit.

373. Five or ten drops of the sal volatile may be given every three or four hours; and twice or thrice in the interval, five or ten drops of brandy may be given in arrow-root done in water. As the diarrhœa and appear-

nnces of exhaustion subside, these remedies are to be subtracted; the bowels are to be watched and regulated, and the strength is to be continually sustained by the nurse's or ass's milk. The brandy has sometimes appeared to induce pain; sal volatile is then to be substituted for it; a dose of magnesia has also appeared to do good.

374. For the state of irritability, the warm bath is a remedy of great efficacy. For the coma a small blister, or sinapism, should be applied to the nape of the neck. A state of exhaustion of the general system, as I have observed elsewhere, by no means precludes the possibility of real congestion of the brain. It rather implies it. In extreme cases, there are not only the symptoms of cerebral congestion during life, but effusion of serum into the ventricles of the brain is found on examination after death.

375. In every case the extremities are to be kept warm by flannel, and the circulation should be promoted in them by assiduous frictions. It is of the utmost importance carefully to avoid putting the little patient into the erect posture. A free current of air is also a restorative of the greatest efficacy.

376. Having thus given a sketch of the hydrocephaloid disease, as it has presented itself to my own observation, I think it will interest you to hear what have been the results of the observations of others, and especially of Dr. Abercrombie, and of the late Dr. Gooch. I have been told, indeed ("Brit. and For. Med. Rev." for April, 1837, p. 325), that an observation made by the former eminent physician preceded mine, in an early volume of the "Edinb. Med. and Surg. Journal" (for Nov. 1818, vol. xiv., p. 581). I mention this circumstance only to show that I have no disposition to claim more than is my due. I must add, however, that Dr. Abercrombie's observation, which was entirely unknown to me, was but an isolated paragraph of a few lines, and, for that reason, however interesting, little calculated to seize the attention of practitioners. Mine was a distinct treatise, under a new and appropriate designation. Does any one think that Dr. Wells's brief account of the disease of the kidney with albuminous urine, in the Transactions of a Society for the Improvement of Medical Knowledge (vol. iii., p. 194), or M. Andral's account of the same disease, in his "Clinique Medicale," ed. 1., t. ii., p. 567, deprive Dr. Bright of the merit, even of originality, in his full description of that disease? No. The cases are precisely parallel, except that Dr. Wells's and M. Andral's accounts are much more than mere incidental paragraphs. Nevertheless, Dr. Bright enjoys the well-merited reputation of having made a most important addition to our knowledge in pathology.

377. Dr. Abercrombie observes, in 1828,—"In the last stage of diseases of exhaustion, patients fall into a state resembling coma, a considerable time before death, and whilst the pulse can be felt distinctly. I have many times seen children lie for a day or two in this kind of stupor, and recover under the use of wine and nourishment. It is often scarcely to be distinguished from the coma which accompanies diseases of the brain. It attacks them after some continuance of exhausting diseases, such as tedious or neglected diarrhœa; and the patients lie in a state of insensibility, the pupils dilated, the eyes open and insensible, the face pale, and the pulse feeble. It may continue for a day or two, and terminate favourably, or it may prove fatal. This affection seems to correspond with the apoplexia ex inanitione of the older writers. It differs from syncope in coming on gradually, and in continuing a considerable time, perhaps a day or two; and it is not, like syncope, induced by sudden and temporary causes, but by causes of gradual exhaustion, going on for a considerable time. It differs from mere exhaustion, in the complete abolition of sense and motion, whilst the pulse can be felt distinctly, and is in some cases of tolerable strength. I have seen in adults the same affection, though it is, perhaps, more uncommon than in children." In a letter which I had the honour to receive from Dr. Abercrombie, that gentleman observes,—"The state of infants which I have referred to, is a state of pure coma, scarcely distinguishable, at first sight, from the perfect stupor of the very last stage of hydrocephalus, the child lying with the eyes open, or half open, the pupils dilated, the face pale. It is difficult to describe distinctly the appearance; but it is one which conveys the expression of coma, rather than of sinking; and I remember, the first time I met with the affection, the circumstance which arrested my attention, and led me to suppose the disease was not hydrocephalus, and the state somewhat different from coma, was finding, on further inquiries, that it came on after diarrhœa, and not with any symptoms indicating an affection of the head. The child recovered under the use of wine and nourishment."

Effects somewhat similar are apt to follow operations on very young children. See Mr. Travers's interesting work upon "Constitutional Irritation," pp, 139—141, published in 1826.

378. Dr. Gooch observes,—"I am anxious to call the attention of medical men to a disorder of children which I find invariably attributed to, and treated as, congestion or inflammation of the brain, but which, I am convinced, often depends on, or is connected with, the opposite state of circulation. It is chiefly indicated by heaviness of head and drowsiness. The age of the little patients whom I have seen in this state, has been

from a few months to two or three years; they have been rather small of their age, and of delicate health; or they have been exposed to debilituting causes. The physician finds the child lying on the nurse's lap, unable or unwilling to raise its head, half asleep, one moment opening its eyes, and the next closing them again, with a remarkable expression of languor. The tongue is slightly white, the skin is not hot; at times the nurse remarks that it is colder than natural. In some cases there is at times a slight and transient flush; the bowels I have always seen already disturbed by purgatives, so that I can scarcely say what they are when left to themselves; thus the state which I am describing is marked by heaviness of the head, and drowsiness, without any signs of pain, great languor, and a total absence of all active febrile symptoms. The cases which I have seen have been invariably attributed to congestion of the brain, and the remedies employed have been leeches and cold lotions to the head, and purgatives, especially calomel. Under this treatment they have gradually become worse; the languor has increased; the deficiency of heat has become greater and more permanent; the pulse quicker and weaker; and at the end of a few days, or a week, or sometimes longer, the little patients have died, with symptoms apparently of exhaustion. In two cases, however, I have seen during the last few hours, symptoms of oppressed brain, as coma, stertorous breathing, and dilated and motionless pupil."

379. But although this morbid affection is scarcely described by former writers, it is, I find, sufficiently familiar to many observing practitioners, on recalling to their minds the circumstances of the singular and interesting state of things attending it; and I am indebted to several friends for notices of cases of this kind.

380. I proceed to exemplify this description, and the appropriate treatment, by adducing several cases. The first I give from my "Medical Essays."

Case 1.—"A little girl, aged four months, was seized with a bowel complaint; the the usual medical attendant prescribed an aperient, which acted too freely. When I saw it on the second or third day of the disorder, the countenance was pale and sunk, and the cheeks cool; it started on being touched; there was a peculiar huskiness of the voice; and the pulse beat from 144 to 150. By giving brandy the pulse was found on the succeeding day reduced to 120, and there was some apparent amendment, although a degree of rattling in the breathing, or on coughing, was now added to the huskiness of the voice. By continuing the brandy the cheeks became warm, and at length somewhat flushed, and the pulse rose to 140. The quantity of brandy was diminished, and cautiously regulated, and the pulse very gradually fell to the natural standard.

"In this case the pallidness and coldness of the cheeks, and the state of the voice and breathing, indicated almost a fatal degree of exhaustion: the frequency of the pulse arising from this cause, was reduced by the brandy; but it was afterwards again increased as the effect, not of the exhaustion, but of the stimulus, and the cheeks recovered their warmth, and sometimes even became flushed. In another case, precisely similar, the state of sinking continued in spite of every remedy, and the little infant lingered, and then expired. I have known such a state of lingering to be continued for several days."

Case 2.—On Sunday, the 21st of March, I was called to an infant three months old, under the following circumstances:—It had been weaned a fortnight; during this period it had been fed with milk and barley-water, and once a day with the addition of bread. It remained well until the Thursday before my visit, when it became affected with fever, restlessness, crying, and moaning, in its sleep, and with diarrhœa, passing several undigested and mucous stools. A dose of calomel was given, which induced sickness. A second dose was then administered, which, in the course of that and the succeeding day, Friday, was followed by sixteen evacuations.

381. During Friday night there was much heat, interrupted sleep, and gripiug pains, followed by offensive evacuations. On the following morning there was some degree of dozing, or coma; the eyes were imperfectly closed, the tunica albugiuea alone being visible, and the mouth was open. This inanimate state, attended by coldness of the cheeks, hands, and feet, would continue for ten minutes, and then there would be some degree of reaction.

382. This state of things continued during the whole of Saturday, the dozing assuming the character of more settled coma. I saw the little patient late in the evening. The cheeks were then pale and cold; the eyes were half open, and unfixed, and unexcited by any external object, however brilliant, and the pupils were moderately dilated, and unmoved on the approach of light; the pulse was 132; the breathing irregular and sighing; the general surface pale, and the hands and feet cold.

383. There were thus the usual symptoms of the comatose stage of hydrencephalus. The condition of the countenance, general surface, and extremities, and the history of the case, however, led me to view it as one of exhaustion, and not of inflammation and effusion within the head. I therefore prescribed five drops of brandy, and three of sal volatile, to be given alternately every hour; and I directed the little patient to be

put once, in the interval of the two hours, to the breast of a young and healthy nurse.

384. Under this discipline there was a gradual but not unchequered amendment. The stupor began to alternate with restlessness, and there were frequent startings; more than once the restlessness was so great as to require the use of a warm bath, by which it was greatly relieved, and quiet and sleep induced. The countenance gradually assumed a more natural and animated appearance and expression, with an occasional smile. The bowels were moved four times on the succeeding day, the evacuations being great.

385. On Monday morning a little magnesia and rhubarb were given, the other remedies having been, and being still continued. The little patient started much less on this day, and slept quietly, and there was no return of restlessness to require the warm bath.

386. On the succeeding days there was an obvious and progressive amendment. The brandy and sal volatile were gradually abstracted, the breast being continued.

387. Case 3.—I was called a short time ago, to see a little girl, aged two years and three quarters, who had laboured under an attack of influenza. The affection of the chest had been severe and protracted, and sixteen leeches had been applied, besides the administration of other depletory measures, before it had subsided.

388. The symptoms of affection of the chest were, however, subdued at last; but the little patient was left extremely exhausted, and in this state a new train of symptoms supervened, not less alarming, and more puzzling than the first. The child fell into a dozing state, and lay with its eyelids but half closed; it moaned when any attempt was made to rouse it; the eyes were unfixed on any external object, the pupils were dilated, yet partially contractile on the influx of light; the pulse was 140.

389. On withdrawing into an adjoining room, the medical gentleman whom I had the pleasure of meeting observed, "hydrencephalus has now supervened, and we must administer calomel." I replied, that I took a different view of the case,—that it resembled hydreucephalus, indeed, but arose from exhaustion, and that brandy, not calomel, would alone save the little patient's life. I referred to the history of the case for sufficient sources of exhaustion; and to the facts detailed in the preceding part of this paper, for the actual occurrence of such cases in practice.

390. We administered brandy, directing thirty drops to be given every two hours, with barley-water in the intervals, and a quarter of a pint of ass's milk twice in the twenty-four hours. The bowels were relieved by magnesia, and the warm water injection.

391. This plan of treatment lowered the number of the pulse, and gradually diminished the severity of the other symptoms. Still the eyes were not to be fixed by presenting any bright object before them; the pupils remained dilated; the tunica conjunctiva became inflamed from exposure between the partially-closed eyelids; and once or twice the fæces were passed involuntarily in bed.

392. The brandy having occasioned pain in the bowels, an effect which I have several times observed, it was given alternately with the spiritus ammonia aromaticus. The rest of the plan was pursued with unexampled assiduity by a most tender mother, who did not once undress, or leave her little patient until she saw it out of all danger. This task was the severer because, although the symptoms which had been detailed subsided gradually and favourably, they were succeeded by an equally severe and sadly protracted aphthous affection.

393. The first symptom of amendment was a diminished frequency of the pulse; the next a restored susceptibility of the pupils to light; then the eyes became attracted and fixed by external objects, and a smile began to play upon the little patient's countenance; the eyelids closed more and more perfectly during sleep, and the conjunctivæ lost their inflamed, injected appearance; the knees were drawn up, and the posture on the side began to be assumed spontaneously.

394. I have notes of two other cases of this kind, but they are so precisely similar to those which I have given, that it appears needless to add to the length of the present lecture, by relating them in detail. I shall rather adduce the further evidence contained in the paragraph of a letter written to me by my friend, Dr. Heming.

395. "The two little children of whom I spoke to you became affected with bowel complaint, and the usual medical attendant gave them some aperient medicine. As they continued to get worse, Dr. Blegborough was consulted. I saw them on December the 10th, 1826.

396. "The youngest, an infant aged nine months, was suffering with aphthous diarrhœa, was very pale and much emaciated, and appeared to be dying. It lingered for two or three days with the symptoms of sinking which you have described, and then expired. The eldest child, a girl aged three years, the principal subject of the short account which I am enabled to give you, had had leeches applied to the temples, and taken calomel and jalap, and its mother was at the time I saw it, applying a cold spirituous lotion to the head. Dr. Blegborough had given it as his opinion that the case was hydrencephalus, and, of course, hopeless; and, in truth, I thought he was right,

for the child was completely insensible to sound or light; the eyes were half closed, and affected with strabismus, and the pupil dilated; its head fell from side to side, and the fæces were passed involuntarily; the skin was blanched, and there was great emaciation. I recommended sinapisms to be applied to the feet; and, if the child should become capable of swallowing, which I did not expect, to give it ass's milk, and to omit all medicine.

397. "When I called on the 12th, I was greatly and agreeably surprised to find this little patient much better. The ass's milk had been taken, and seemed to agree. As the bowels were still moved frequently and involuntarily, and as I did not now think the symptoms depended upon effusion into the brain, though I confess I was much puzzled to know to what cause they were to be assigned, I recommended small doses of laudanum to be given until the diarrhœa should be checked. On the 14th the motions were less frequent, and the little patient was better in every respect. On the 18th although very pale, the child was still further improved. It was sent into the country, and a few months afterwards it was perfectly well."

398. For the following case I am indebted to Dr. Tweedie:—

"In September last I was requested by a respectable medical practitioner to visit an infant, which he suspected to be dying from effusion into the brain. On reaching the house I found a little child, about four months old, lying in a state of complete coma, from which it could not be roused. On raising the eyelids the pupils were found natural, though the eye was dull. The pulse was rapid and feeble; the breathing frequent and occasionally interrupted and suspirious, and the bowels were loose, the evacuations consisting chiefly of mucus.

399. "On inquiring into the previous history I was informed that the mother having accepted the situation of wet-nurse in a family, had placed this child, which was then in perfect health, under the care of another nurse, who had just weaned her own child, at the age of nine months; that very soon afterwards it began to be sick, and the bowels became relaxed, and as it did not get better it was removed to the house of a relation who attempted to rear it by spoon-diet. It was soon observed to rally under this change, but the diarrhœa continued in spite of remedies administered with the view of checking it. Ten days afterwards it became again fretful and uneasy, the bowels being still purged; then coma gradually supervened, and it died nine days afterwards, within twelve hours of my visit.

"Permission could not be obtained to examine the body."

400. It was after my paper was read to the *Medico-Chirurgical Society*, that I had the satisfaction of seeing the publication of the late Dr. Gooch, in which that acute physician has given cases similar to those just detailed; I cannot but be sensible of the flattering manner in which he alluded to my observations.

401. As the cases and remarks of Dr. Gooch contain the only ones relating to the present subject, which I have found in medical writings, I think it important to add some of them to those which I have already deduced from my own observation, and that of the gentlemen already quoted:—

402. "A little girl, about two years old, small of her age, and very delicate, was taken ill with the symptoms which I have above described. She lay dozing, languid, with a cold skin, and a pulse rather weak, but not much quicker than natural. She had no disposition to take nourishment. Her sister having died only a week before of an illness which began exactly in the same way, and which was treated by leeches and purgatives, and some doubts having been entertained by the medical attendant of the propriety of the treatment, leeches were withheld; but the child not being better at the end of two days, the parents naturally anxious about their only surviving child, consulted another practitioner. The case was immediately decided to be one of cerebral congestion, and three leeches were ordered to be applied to the head. As the nurse was going to apply them, and during the absence of the medical attendants, a friend called in who had been educated for physic, but had never practised it, and who had great influence with the family; he saw the child, said that the doctors were not sufficiently active, and advised the number of leeches to be doubled. Six, therefore, were applied; they bled copiously; but when the medical attendants assembled in the evening, they found the aspect of the case totally altered, and that for the worse: the child was deadly pale, it had scarcely any pulse, its skin was cold, the pupils were dilated and motionless when light was allowed to fall on them, and when a watch was held to its eyes it seemed not to see; there was no squinting. Did this state of vision depend on the pressure of a fluid effused into the brain since the bleeding, and during this exhausted and feeble state of circulation, or did it depend on the circulation of the brain being too languid to support the sensibility of the retina? It is well known that large losses of blood enfeeble vision. I saw a striking instance of this in a lady who flooded to death. When I entered the chamber she had no pulse, and she was tossing about in that restless state which is so fatal a sign in these terrific cases. She could still speak, asked whether I was come (she knew I had been sent for), and said, 'am I in any danger?

How dark the room is. I can't see.' The shutters were open, the blind up, and the light from the window facing the bed fell strong on her face. I had the curiosity to lift the lid and observe the state of the eye; the pupil was completely dilated, and perfectly motionless, though the light fell strong on it. Who can doubt that here the insensibility of the retina depended on the deficiency of its circulation? But to return to the little patient. The next day she had vomited her food several times; it was therefore directed that she should take no other nutriment than a dessert-spoonful of ass's milk every hour, and this was strictly obeyed, and continued for several days. The child wasted, her features grew sharp, and every now and then she looked fretful, and uttered a faint squeaking cry; the eyeballs became sunk in the socket, like those of a corpse that had been dead a month; the skin continued cool and often cold, and the pulse weak, tremulous, and sometimes scarcely to be felt. Under this regimen, and in this way, she continued to go on for several days. At times she revived a little, so as to induce those who prescribed this treatment, to believe confidently that she would recover, and she clearly regained her sight, for if a watch was held up to her she would follow it with her eyes. She lived longer than I expected, a full week, and then died with the symptoms of exhaustion, not with those of oppressed brain. The head was opened by a surgeon accustomed to anatomical examinations, and nothing was found but a little more serum than is usual in the ventricles.

403. "If the reader has perused the foregoing case attentively, and has reflected on it, he will, of course, draw his own inferences. I can draw no others than these, that the heaviness of head and drowsiness, which were attributed to congestion in the brain, really depended on a deficiency of nervous energy; that the bleeding and scanty diet aggravated this state, and insured the death of the child; also, that the state of the eye which so speedily followed the loss of blood, and which resembled that occasioned by effusion, did in reality depend on a deficiency of circulation of the brain: a fact of considerable curiosity and importance.

404. "I will now relate a case similar in the symptoms, but very different in the treatment and results. I was going out of town one afternoon last summer, when a gentleman drove up to my door in a coach, and intreated me to go and see his child, which he said had something the matter with its head, and that the medical gentleman of the family, was in the house, just going to apply leeches. I went with him immediately, and when I entered the nursery I found a child ten months old, lying on its nurse's lap, exactly in the state which I have already described: the same unwillingness to hold its head up, the same drowsiness, languor, absence of heat, and all symptoms of fever. The child was not small of its age, and had not been weak, but it had been weaned about two months, since which it had never thriven. The leeches had not been put on. I took the medical gentleman into another room, related to him the foregoing case, and several similar to it, which had been treated in the same way, and had died in the same way. Then I related to him a similar case which I had seen in the neighbouring square, which had been treated with ammonia in decoction of bark, and good diet, which had recovered; not slowly, so as to make it doubtful whether the treatment was the cause of the recovery, but so speedily that at the third visit I took my leave. He consented to postpone the leeches, and to pursue the plan which I recommended. We directed the gruel diet to be left off, and no other to be given than ass's milk, of which the child was to take, at least, a pint and a half, and at most a quart, in the twenty-four hours. Its medicine was ten minims of the aromatic spirit of ammonia in a small draught every four hours. When we met the next day, the appearance of the child proved that our measures had been right; the nurse was walking about the nursery with it upright in her arms; it looked happy and laughing. The same plan was continued another day; the next day it was so well that I took my leave, merely directing the ammonia to be given at longer intervals, and thus gradually withdrawn. The ass's milk to be continued, which kept the bowels sufficiently open without aperient medicine.

405. "So inveterate is the disposition to attribute drowsiness in children to congestion of the brain, and to treat it so, that I have seen an infant, four months old, half dead from the diarrhœa produced by artificial food, and capable of being saved only by cordials, aromatics, and a breast of milk; but because it lay dozing on its nurse's lap, two leeches had been put on the temples, and this by a practitioner of more than average sense and knowledge. I took off the leeches, stopped the bleeding of the bites, and attempted nothing but to restrain the diarrhœa and get in plenty of nature's nutriment; and as I succeeded in this, the drowsiness went off and the child revived. If it could have reasoned and spoken, it would have told this practitioner how wrong he was. Any one who, from long defect in the organs of nutrition, is reduced so that he has neither flesh on his body nor blood in his veins, well knows what it is to lay down his head and doze away half the day without any congestion or inflammation of his brain. This error, although I have specified it only in a particular complaint of children, may be observed in our notions

and treatment of other diseases, and at other periods of life. If a woman has a profuse hæmorrhage after delivery, she will probably have a distressing headach, with throbbing in the head, noises in the ears, a colourless complexion, and a quick, weak, often-thrilling pulse, all which symptoms are greatly increased by any exertion. I have seen this state treated in various ways by small opiates, gentle aperients, and unstimulating nourishment, with no relief. I have seen blood taken away from the head, and it has afforded relief for a few hours, but then the headach, throbbing, and noises, have returned worse than ever; the truth is, that this is the acute state of what, in a minor degree, and in a more chronic form, occurs in chlorosis, by which I mean pale-faced amenorrhœa, whether at puberty or in after-life. It may be called acute chlorosis, and like that disease is best cured by steel, given at first in small doses, gradually increased, merely obviating constipation by aloetic aperients.

406. "I shall not encumber this paper with a multiplicity of cases, but state that the above are only specimens of a class of which I have seen enough to convince me that they deserve the attention of the profession. If I had any doubt about this, this doubt would be removed by the fact that Dr. Marshall Hall has already recognised them, and described them in a paper which has been read at the *Medico-Chirurgical Society*. He has, therefore, anticipated me in announcing them. The only difference between our experience seems to be this, that he attributes the state which I have been describing to the diarrhœa produced by weaning, or to the application of leeches for some previous complaint. In most of the cases I have seen, however, the child has had no previous illness, and the leeches have been applied subsequent to the drowsiness, and as a remedy for it."

407. In regard to the difference in the experience of Dr. Gooch and myself, I would observe, that that of Dr. Abercrombie plainly concurs with mine, and that, in all cases seen by Dr. Gooch himself, the bowels had already been disturbed by purgatives, so that a source of exhaustion had existed in them. All the cases which I have seen or heard of, and those of Dr. Heming and of Dr. Tweedie, alike involved a state of exhaustion.

408. The first stage of the affection which has been described, or that of irritability, may, indeed, depend on a previous disordered condition of the stomach and bowels, but the state of torpor is obviously the result of exhaustion.

The rest of Dr. Gooch's observations are highly interesting.

409. I possess other cases of this interesting disease. One I visited some years ago with Dr. James Johnson and Mr. Balderson; another was the infant son of Mr. Michele, now a fine boy; a third was the nephew of Mr. Fleetwood; a fourth I visited but the other day with Mr. Vickers. All these gentlemen belong to our profession. It would be useless to enter into further details.

The Croup-like Disease.

500. If the very existence of the *hydrocephaloid* disease was unknown to the profession previously to my researches, the *nature* of that of which I now proceed to speak, the *croup-like* disease, could not be understood until the reflex modes of action of the excito-motory property, with the *system* of the true spinal marrow, and its incident and reflex nerves, were demonstrated.

501. The origin of this disease, to which I will not at present give a name, was erroneously referred to the cerebrum by the late Dr. J. Clarke, to whom we owe its detection; and to compression and consequent paralysis of the pneumogastric and its recurrent nerves, by the late Dr. Hugh Ley, to whom we are indebted for an otherwise invaluable estimate upon it. It is, in reality, an affection of the true spinal or excito-motory system. It *originates* in

I. *a. The Trifacial*, in teething;
b. The Pneumogastric, in over—or improperly-fed infants;
c. The Spinal Nerves, in constipation.

These act through the medium of

II. *The True Spinal Marrow*, and

III. *a. The Superior Laryngeal*, the constrictor of the laryux;
b. The Intercostals and *Diaphragmatic*, the motors of respiration.

This mode of viewing an important *Class* of diseases is entirely new, and is the only true one. It points, too, to the *causes* and the *cure*.

502. The same mode of viewing this important subject leads us to give its proper place to *each* of the series of symptoms: the *spasmodic* or *spinal* are the *first* in order; the *cerebral* the *second*. We are thus enabled to see the just relation and position of effusion into the ventricles of the brain to this disease; it is the *effect*, not the *cause*.

But I find that this subject *must* be reserved for another lecture.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, March 17th, 1838.]

LECTURE VII.

THE CROUP-LIKE DISEASE. — *Disputes regarding the nervous system; Mr. Newport and Professor Grant; parallel passages. Causes of the croup-like convulsion; analysis of its symptoms. Dr. J. Clarke's description of the disease. Is the origin of the disease cerebral? Remarks of Dr. Merriman. Reasons for not adopting Dr. Hugh Ley's opinion. Probable theory of the disease. Treatment. Paralysis from dental irritation; remarkable case. Paralysis from intoxication. Successful performance of tracheotomy by Mr. Sampson.*

GENTLEMEN :—Before I proceed to the proper subject of this lecture, I must briefly allude to the exception that has been taken to § 15 and § 16 of Lecture I. The former, I find, by the concurrent testimony of *two* of Professor Grant's pupils, of 1832, to be perfectly correct; and the latter, by inference, from the admission of all parties. The points in question are *four*:—1. The *existence*, and, 2, the *function*, of *the third column* of nerves in the articulata; 3. The *dates* of the publication of these discoveries; 4. The *ingratitude* of a pupil who attempts to deprive his teacher of the merit of having taught both, and made one, of them.

503. Now the notes of the two pupils of Dr. Grant, state, that he showed and explained, in 1832, the plate of Prof. Müller, published in 1828, portraying the third column in the scorpion, and taught that this column was *aganglionic* in its structure, and *motor* in its function.

504. After this, the individual alluded to, gratuitous pupil of Dr. Grant, and, through his means, of the other medical professors of the University, pretended to have made his discovery in the lobster, at the suggestion of Sir C. Bell, in 1833, and published as such in the "Philosophical Transactions" for 1834. See *particularly* pp. 406 408. The most *complete* refutation of the pretensions of this individual is afforded by Dr. Baly's notes, and those two paragraphs. I therefore subjoin them here :—

Extract from Dr. Baly's Notes of Professor Grant's Lectures in 1832.

1832.

"Müller has found in the scorpion, on the side of the knotted chord, a nerve passing down, having no connection, tapering towards the last ganglion, where it is removed with more difficulty." &c.

Dr. Baly gives a sketch of Müller's plate, made with the pen, during the lecture.

"We have seen nerves apparently corresponding to the nerves of *sensation*, *with* ganglia; and to the nerves of *motion*, *without* ganglia. Also, nerves of vegetative life, thought to supply the office of the nervus vagus and sympathetic."

N.B. Mr. Storrar's Notes are to the same effect.—See LANCET, p. 748.

Extract from Mr. Newton's Paper in the "Philosophical Transactions" for 1834, p. 406.

1834.

"It was during the early part of the summer of 1833, that I first had an opportunity of conversing with Sir C. Bell, respecting the nervous system of insects, when he suggested a closer examination of the chords than I had then made, to ascertain whether a double nervous column, one portion for sensation and the other for motion, exists in the *invertebrata*, as in the higher animals. He at the same time pointed out one of the *crustacea*, the lobster, as perhaps the most eligible for the inquiry. At that time I had no hopes of succeeding in demonstrating the parts by dissection, although I believed they really did exist. In the month of August, after many dissections and examinations of the animal in its recent state, I began first to hope for success; and in the

beginning of September completed a preparation of the nervous system of the lobster, that appeared to show the two motor and sensitive columns." &c.—p. 406.

Second Extract from Mr. Newport's Paper in the "Philosophical Transactions" for 1834, p. 408.

1834.

"The detection of a double spinal column in the lobster has since led me to examine more closely the nervous system of the scorpion, one of the *arachnida*. *Upon showing* my dissection of the lobster to Professor Grant, he directed my attention to a structure observed in the scorpion by Prof. Müller of Bonn, which *has been thought* to be the *motor* tract. This structure I had not at that time observed."—p. 408.

When we remember that these two pupils of Dr. Grant sat beside each other, we cannot but perceive that one of them has been guilty of "statements not in *strict* accordance with facts."

505. These, then, are the *facts* of the case. They do not concern me individually, except as being the truth. Much mystification and subterfuge have been employed in a recent discussion, but you have only to keep steadily in mind the *subject* of that discussion, viz., the *third abdominal nervous column* in the articulata,—its discovery, and the discovery of its *function*. (See § 15.)

506. But I proceed to the proper subject of this lecture.—The symptoms of hydrocephalus, and of the hydrocephaloid disease, are affections of the *cerebral* functions in the *first* instance, and of the *true spinal* in the *second*. In the croup-like convulsion this order is reversed, and the *true spinal* system is *first* affected, and the *cerebral* subsequently. This is an interesting and important view of the subject. It teaches us the order, not only of the symptoms, but of the remedies to be employed.

The Croup-like Convulsion.

507. In introducing to your notice the croup-like disease of children, I must advert to a subject which I shall notice more fully hereafter, viz., the division of the diseases of the true spinal system; 1. Into those originally seated in the incident, *excitor* nerves, of which the *type* is given in the figure in § 49; 2. Into those having their seat in the centre of this system, of which the *type* is given, § 34; and 3. Into those affecting the course of the motor nerves, and represented § 33.

The croup-like convulsion belongs to the first of these divisions. It arises from the irritation of

I. 1. *The Trifacial*,
2. *The Pneumogastric*, or
3. *The Spinal Nerves*,

during *dentition*, *indigestion* or loaded stomach, or *constipation* or loaded bowels. The effect of this irritation is conducted to the

II. *True Spinal Marrow.*

It is then reflected upon

III. 1. *The Superior Laryngeals*,
2. *The Diaphragmatic*,
3. *The Intercostals*,
4. *The Abdominal Nerves.*

All spasmodic diseases might be represented in a similar manner, and thus a view of these affections will be given, at once novel and distinct.

509. The general question of *convulsions* is one of the greatest interest. That the whole *class* of convulsive diseases consists of affections of the true spinal system, there is no longer any doubt. But these diseases do not all *originate* in this system. Some of them originate in the cerebrum; they then arise

1. From *counter pressure* in diseases, or
2. From *contre-coup* in injuries of the encephalon;
3. From *irritation* in diseases of the *meninges*, or at the *base* of the brain;
4. From *exhaustion*.

510. In this manner we solve the difficult question of convulsions arising from affections of parts not endowed with the excito-motory property. Allow me to refer you to the observations formerly made upon the subject, § 272, and § 273.

511. It is in this manner that we explain the occurrence of convulsions in encephalitis and hydrocephalus, in meningeal or other affections of the base of the brain, or of the spinal marrow, and the effects of extreme exhaustion. In a word, convulsions belong to the *later period*, and the *close* of *all* the diseases of the nervous system, as, on the other hand, repeated convulsions eventually affect the encephalon.

512. But of convulsions *originating* in the true spinal system, some are *centric* others *eccentric*. The former consist of disease of the true spinal marrow itself, the latter of affections of the incident nerves and, through these, of the centre of the system. Such a case is the croup-like convulsion.

513. In treating of this affection, I propose to include eccentric convulsions in children generally, for they are parts of the same whole.

The principal *causes* of convulsions in children, in a practical point of view, are,

1. *Dental Irritation.*
2. *Gastric Irritation.*
3. *Intestinal Irritation.*

And here I must make the important, the all-important, practical remark, that I have *never* seen the measures suggested by this view of the causes, when *early* and *effectual* enforced, fail in remedying this disease.

514. Besides these especial causes, there are others which act upon the nervous centres. Passion, vexation, and certain odours, are of this class; and, singular as it may appear, the state of sleep *predisposes*, at least, to attacks of convulsions.

515. It is interesting to observe how the series of *symptoms* in the convulsions of infants are affections of the excito-motory functions.

516. Amongst the most frequent of the symptoms is *strabismus*; in a second case we may have contractions of the thumb and fingers, of the wrists, and of the toes and feet; next comes that affection of the *larynx* and of the muscles of *inspiration*, which has been so well described by the late Dr. John Clarke, as a "peculiar species of convulsion;" in other cases the *larynx* is actually *closed*, and there are an expression of fright, and, sometimes, retraction of the head, and violent convulsive *expiratory* efforts; in a fifth case there is an affection of the *sphincters* of the bladder and intestine, even leading to the idea of calculus. Compare § 38, &c.

517. One or more of these symptoms, or a sardonic smile, lead to a general *convulsion*.

Strabismus is the first of the symptoms which I have enumerated. Like the rest, it is sometimes acute, sometimes chronic in its character. The eye is turned inwards, most frequently, sometimes obliquely. The strabismus is variable, obviously augmented by teething, improper food, constipation or fret of the bowels, &c., and it is relieved by relieving these states of irritation. It is equally obviously increased by nervous agitation, by calling the muscles into greater action than usual, &c.

518. Very similar to the undue action of the muscles of the eye, inducing strabismus, is that of the muscles of the fingers and toes, inducing clenched hands and contraction of the feet. This affection is noticed by Underwood and Clarke, and particularly by the late Dr. Kellie of Leith; the last named writer published a paper expressly on it. It is augmented by causes similar to those which augment strabismus. It is, like strabismus, apt to assume a chronic character, and it always constitutes a symptom portentous of other forms of spasmodic and convulsive affection.

519. The peculiar convulsion described by Dr. Underwood, and especially by Dr. John Clarke, must next be noticed. Dr. Underwood describes it as combining a little blueness of the lips, slight turning up of the eyes, a *peculiar sound of the voice* (somewhat like *croup*), and a very quick breathing at intervals, frequently coming on during sleep, or any exertion of the body, or transient surprise.

520. Dr. J. Clarke's description of this disease is highly interesting. He observes:—

"This convulsive affection occurs by paroxysms, with longer or shorter intervals between them, and of longer or shorter duration in different cases, and in the same case at different times.

"It consists in a peculiar mode of inspiration, which it is difficult accurately to describe.

521. "The child having had no apparent warning, is suddenly seized with a spasmodic inspiration, consisting of distinct attempts to fill the chest, between each of which a squeaking noise is often made; the eyes stare, and the child is evidently in great distress; the face and extremities, if the paroxysm continues long, become purple, the head is thrown backwards, and the spine is often bent, as in opisthotonos; at length a strong expiration takes place, a fit of crying generally succeeds, and the child, evidently much exhausted, often falls asleep.

"In one of these attacks a child sometimes, but not frequently, dies.

"They usually occur many times in the course of the day, and are often brought on by straining, by exercise, and by fretting; and sometimes they come on from no apparent cause.

522. "They very commonly take place after a full meal, and they often occur immediately upon waking from sleep, though, before the time of waking, the child had been lying in a most tranquil state. As the breathing is affected by these paroxysms the complaint is generally referred to the organs of respiration, and it has been sometimes called chronic croup; but is very different from croup, and is altogether of a convulsive character, arising from the same causes, and is relieved by the same remedies as other convulsive affections.

523. "Accompanying these symptoms, a bending of the toes downwards, clenching of the fists, and the insertion of the thumbs into the palm of the hands, and bending the fingers upon them, is sometimes found, not only during the paroxysms, but at other times.

"Clenching the fist with the thumb inserted into the palm of the hand, often exists for a long time in children without being much observed, yet it is always to be considered as an unfavourable symptom, and frequently is a forerunner of convulsive disorders, being itself a spasmodic affection.

524. "It rarely happens that a child recovers from an attack of this sort, unless the progress of the disorder has been interrupted by a timely application of proper remedies, without a general convulsion. Then the friends become alarmed, and a disease which had existed for two or three months, is, for the first time, considered to be important enough to require medical assistance, after all the farrago of popular medicines, such as fit-drops, soot-drops,

assafœtida, &c. have been ineffectually applied.

525. "Convulsions of this description seldom, if ever, occur after the expiration of the third year of a child's life, and not often in children which have lived by sucking till they have teeth, and have never taken animal food till the dentes cuspidati have come through the gums; this, however, is liable to some exceptions."

526. The next question is that of the *nature* of this affection; and, in discussing this question, I must particularly notice the opinion of the late Dr. J. Clarke, that it is *cerebral* in its origin; and of the late Dr. Hugh Ley, that it arises from the compression of enlarged glands upon the pneumogastric nerve.

527. In reference to the opinion of the cerebral origin of this disease, I may observe:—

1. That the *changes* in the symptoms, whether for better, or for worse, are far too sudden to be dependent on *disease* within the head.

2. That the effects of its causes and of remedies are of a character totally different from what would be seen in such disease.

3. Hydrocephalus,—I mean tubercular hydrocephalus, — does not produce the croup-like convulsion. This statement must, however, be received with caution, and be submitted to new observation.

528. Meantime I may add the following remark with which I have been favoured by Dr. P. Hennis Green. This gentleman observes:—

"I have looked over 66 cases of acute and chronic meningitis occurring in children, which I possess in manuscript, and do not find a single example of the coexistence of 'crowing inspiration.' Most of the cases were examples of the 'tubercular' form. It should, however, be remarked that all were cases of the disease occurring in children above *twelve months* of age, and 'laryngismus stridulus,' I believe, generally attacks children under that age."

In reference to the opinion of the croup-like convulsion being dependent upon compression of the pneumogastric nerves, I must call your attention to the following observations:—

529. Dr. Merriman observes:—"It is by no means an uncommon affection of children, arising generally from *improper feeding*, and close and confined apartments. If timely attended to, the complaint commonly yields to *daily* aperients, so as to produce at least two copious motions, and continued doses of soda, a strong infusion of burnt sponge, with proper attention to diet and regimen. When the head is manifestly affected, cupping-glasses behind the ears are required: but when the patient has *cold*, *pale*, *flabby cheeks*, as I have not unfrequently observed in this disease, abstraction of blood is rather injurious than beneficial.

530. "*In two cases* of this kind, which were under my care nearly at the same time, *the children died in fits.* They were both opened by Mr. Sweatman, a very skilful anatomist, but *not the slightest appearance of cerebral affection* could be discovered in either of them. The principal deranged structure discovered, was a collection of small glandular swellings in the neck, pressing upon the par vagum."

531. It has been recently attempted, by Dr. Hugh Ley, to found the pathology of this interesting disease upon observations, such as that adduced by Dr. Merriman, but I think unsuccessfully.

532. *In the first place*, as far as my memory and judgment serve me, the cases adduced to support this view, are not cases in point, but, in reality, cases of other diseases.

533. *Secondly*, supposing pressure upon the pneumogastric to exist, it would induce totally different phenomena from those actually observed in this disease; and it would not explain the *series* of phenomena which actually occur in it; for,

534. *Firstly*, such pressure would induce simple *paralysis.*

This would, in the first place, affect the recurrent nerves, and the dilator muscles of the larynx; it would induce a partial but *constant* closure of that orifice,—a permanent state of dyspnœa, such as occurred in the experiments of Legallois, or such as is observed to be excited in horses affected with "*cornage*" or *roaring*, as described by M. Dupuy in his treatise "De la Fluxion Périodique," 1829, p. 117, &c.

535. *Secondly.* It would induce paralysis of the inferior portion of the pneumogastric, with congestion in the lung or lungs, and the well-known effects upon the stomach of the division of this nerve, with paralysis of the cardia.

The disease in question, on the contrary, variously designated, "*peculiar convulsion*," "spasm of the glottis," &c., is obviously a *part* of a more general *spasmodic* affection, and frequently, indeed most frequently, comes on in the midst of the first *sleep*, in the most *sudden* manner; receding equally *suddenly*, to return, perhaps, as before, after various intervals of days, weeks, or even months. Very unlike paralysis from *any* cause. Nay, the convulsive efforts in the muscles about the larynx are frequently quite obvious. There is even opisthotonos, or emprosthotonos, in some cases.

536. *Thirdly.* It not unfrequently involves or accompanies, as I have said, *other* affections *indisputably spasmodic*, as distortion of the face, strabismus, contractions of the thumbs to the palms of the hands,—of the wrists, feet, toes, general convulsions, sud-

den dissolution,—a series of phenomena totally unallied to paralysis.

537. *Fourthly.* Indeed the larynx is sometimes *absolutely closed*,—an effect which *paralysis* of the recurrent nerve, and of the dilator muscles *cannot* produce.

538. *Fifthly.* Paralysis from the pressure of diseased glands would be a far less *curable* disease, a far *less variable* disease, a far *less suddenly fatal* disease than the croup-like convulsion.

539. *Sixthly.* Almost all recent cases are at once relieved by attention to three or four things, viz.: the state, 1, of the *teeth*; 2, of the *diet*; 3, of the *bowels*; and 4, by change of *air*; they are as obviously produced or reproduced by the agency of errors in one or more of these.

540. *Seventhly.* In fact, the croup-like convulsion is a *spasmodic* disease, excited by causes situated in the nervous centres, or eccentrically from them; in a case of spina bifida already mentioned, a croupy and convulsive inspiration was induced by gentle pressure on the spinal tumour; in cases from teething the attack has been induced and removed many times by *teething*, and by freely *lancing the teeth*, by crudities, and by emetics and purgatives, by change of air, &c.

541. *Eighthly.* There is a series of facts which prove the connection of this disease with other forms of convulsions in children, and with epilepsy in the adult subject.

542. *Ninthly.* In protracted cases, congestion and effusion within the head occur as *effects* of this disease.

543. *Lastly.* Innumerable cases of undoubted croup-like convulsion have occurred, in which no enlarged glands could be detected in any part of the course of the pneumogastric nerve.

544. But if the contiguity of enlarged glands with the pneumogastric have any concern, in any case, in causing this disease, I believe the action is one totally different from that assigned, and not suspected by the author of this opinion. It is obviously an action upon this nerve, as an *incident excitor* nerve, and not as a mere *motor* or *muscular* nerve.

545. I must here detail an experiment upon the pneumogastric, made by Mr. Broughton, but hitherto unapplied to any question in physiology or pathology. The pneumogastric was laid bare in a donkey, and pinched *continuously* by the forceps; the animal made a sudden act of inspiration and of deglutition. The nerve was divided; the *upper*, or *incident* portion of the nerve, was pinched with the same effect as before; the *lower* extremity of the nerve was pinched without any effect.

I may here, also, refer once more to the interesting experiments by M. Dupuy, p. 130, &c. for a similar fact.

546. In this manner, I conceive, *irritation* of the pneumogastric in the neck *may* have induced the croup-like convulsion. *Pressure* upon this nerve, inducing paralysis of its remote extremity, *could not* possibly induce the phenomena in question.

547. It would be difficult to adduce a more convincing proof of the *pathological* and *practical* importance of the views of the nervous system, which I am laying before you.

548. I venture to *suggest* another view of this matter as nearer the truth, viz., that this disease is induced through the *fifth* pair of nerves in *teething*, the *pneumogastric* in indigestion, and *spinal* nerves in constipation, as parts of the excito-motory system. The view itself *points* to the most useful and efficient *remedies*, and this is highly important; it points to the teeth, indigestion, and constipation, as *causes*, and to the well-known means of removing them; it points to the important objects involved in change of air, mental quiet, &c.

549. If, instead of the popular remedy, (the warm bath), the *gum-lancet*, and full warm water *enema*, were *instantly* administered, many little patients would be saved from the effects of this terrible disease. The diet should be barley-water only.

550. The respiration is actually arrested by closure of the larynx; there are forcible expiratory efforts only, or principally, in the actual convulsion. This need scarcely be described; the eyes are distorted from their axes; the face is drawn into horrible forms; the mouth is filled with foam; the body and the limbs are variously and shockingly convulsed. The countenance is livid with venous blood, affording an index to the condition of the brain. There is perfect coma, sometimes long-continued, or there may be sudden dissolution.

551. Sometimes a more transient and partial convulsive movement occurs, like an electric shock. In one deeply interesting case, such a convulsive affection was sometimes ushered in by a sardonic smile. In other moments the little boy was obviously expecting the shock in alarm.

552. In another very interesting case there were strangury and tenesmus, symptoms leading to the suspicion of calculus. The lancing of the gums afforded immediate relief.

553. As in the affection noticed in my last lecture, cerebral disease was described as frequently leading to convulsion; so, in those which I have just mentioned, the convulsion frequently leads eventually to cerebral disease, especially congestion and effusion. The due relation of the disease of the cerebral and true spinal subdivisions of the nervous system is plainly seen. Hitherto there has been little but confusion in our views, both of the pathology and treatment of these several diseases.

554. We may now discern that, whilst in

the cerebral diseases our remedies were chiefly directed to relieve the morbid condition of the arterial or capillary circulation within the head, in the diseases of the true spinal system, our efforts must be made to remove the cause, or causes, of these diseases, whilst we guard against their effects, viz., undue venous congestion of the cerebrum, and of effusion.

555. I need scarcely advert to the erroneous views, and, consequently, erroneous mode of treatment of this affection, of those authors who have considered it as originally an affection of the encephalon. Cause has been mistaken for effect, and effect for cause. The effusion, for example, which is the effect of the previous convulsive struggles, has been considered as their exciting cause. The whole confusion upon this point has arisen from not observing to what subdivision of the nervous system the first symptoms belong. I quite agree with Dr. Merriman in condemning, as useless, or rather as injurious, the indiscriminate and lavish detraction of blood.

556. The proper mode of treatment comprises the remedies—

1. *Against the attacks.*
2. *In the attacks, and in the threatening of the attack.*
3. *Against their effects.*

557. The remedies against the attacks, or the prevention, consists in avoiding all the exciting causes: dental, gastric, intestinal irritation; passion; vexation; disturbance; interrupted sleep, &c.

558. The remedies in the threatening of attacks consist in the watchful and prompt repetition of the same treatment; lancing the gums, relieving the stomach and the bowels. The *sleep* especially should be watched, and if there be a sardonic smile, or starting, or other symptoms, the little patient must be *gently* awoke, and the remedies just enumerated should be administered.

559. After the gum-lancet I would advise a copious enema of warm water.

If there be great threatening of an attack, I would tickle the fauces, dash cold water on the face, and irritate the nostrils, having the patient placed, as speedily as may be, in the warm bath.

560. To guard against the effects of the attacks, we may deplete the blood vessels about the head with cupping, or leeches, apply an alcoholic lotion constantly all over the head, or, if the case be urgent, the ice-cap.

561. In addition to these measures, the secretions must be corrected, mild mercurials being given, perhaps, to affect the system; afterwards change of air is of undoubted efficacy; and a very mild tonic plan may be added with advantage, as minute doses of the sulphate of quinine, of the carbonate of iron, &c. Sponging with *warm* salt and water is also a valuable auxiliary remedy.

562. It is impossible to misconceive the vast importance of this subject. If anything could add to this importance, it is the fact that the convulsions of infancy frequently lay the foundation of epileptic attacks in youth, or adult age. Sometimes the transition is so gradual and continuous, that the two affections are proved to be obviously the same.

The subject of *dentition* has not even yet been fully investigated, in reference to convulsion. Is the *temperature* augmented? This point should be determined by a thermometer. Is there a state of *sub-inflammatory* action? And may not *this* be subdued by scarification of the gums, on the same principle as inflammation of the conjunctiva? Does this view afford us a new and important motive for a more frequent and extensive use of the gum-lancet? May the *excitation* of the trifacial nerve be thus removed, and its *effect* subdued? With these objects the gums should be fully divided, not once, or occasionally, but *twice*, or even *thrice, daily*. Anything rather than repeated attacks, which may lead to convulsion, and eventually to cerebral disease and enfeebled intellect, or crippled limbs.

With the same objects, the diet and the condition of the bowels must be attended to with *equal* energy. *All* irritation must be avoided, and amongst these *drastic* medicines must be arranged. A young nurse's or asses' milk should constitute the former. Enemata of warm water may be used effectually to relieve the bowels, night and morning.

The tinctura hyoscyamis, and the hydrocyanic acid, are important auxiliaries, but especially change of air.

A cold lotion, the ice-cap, perhaps leeches, must be used to guard the head; the feet must be fomented, and kept carefully warm.

563. I shall conclude this lecture by calling your attention to a case not hitherto well known to the profession, viz., *paralysis from dental irritation.*

A little girl, aged twenty months, was taken, when suffering from dentition, with loss of the power of elevating the right arm —that of closing the hand remaining; there was no *other* symptom of cerebral affection. The suffering from dentition was undoubted, I therefore concluded that the case was one of paralysis from teething.

564. The gums were freely lanced, the bowels well moved, the diet strictly regulated; and, for *fear* of hidden disease within the head, two leeches were applied. An embrocation was prescribed for the arm.

A few days after the attack of paralysis, this little girl was seized, in the early part of the night, with a fit of crowing inspi-

ration. This event confirmed *me* in my diagnosis.

The event justified the view I had taken. The child recovered *perfectly*, without any energetic remedy being used for cerebral affection, by continued attention to the state of the gums, the stomach, and the bowels; an event which could scarcely have occurred, from such simple measures, had there been such decided affections, arising from cerebral disease.

565. This case was watched with peculiar interest, from the circumstance of its occurring in the family of a medical friend, Mr. Grant, of Thayer-street.

566. But I will give this interesting case in Mr. Grant's own words:—

"M. A. G——, at twenty months, has been suffering for some time from dentition, being fretful, and having a cough during the night. This morning, April 30th, 1835, her mother observed that she was incapable of raising the right arm; she retained the power of swinging the arm backwards and forwards, and bending the forearm on the arm, but had not the least power to raise the arm itself, as if the deltoid muscle only was paralysed. On examining the arm the child suffers no pain, and there is not the least reason to believe that any accident could have occasioned this loss of power. The general health of the child, with the exception above mentioned, is excellent; appetite good; bowels are every day relieved.

"Dr. Marshall Hall, on seeing the child, recommended a gentle emetic, followed by a dose of castor-oil; the gums, over the four eye teeth, which are all coming forwards, to be carefully lanced every second day; and, alternately, an embrocation to the arm, and a light unirritating diet.

"May 7th. Little alteration in the state of the arm, which the child is perfectly unable to raise in the smallest degree. The castor-oil is given every morning, which produces free and healthy evacuations; the gums have been repeatedly lanced, but the teeth do not advance; she still coughs during the night, but last night she had several fits of coughing, resembling the convulsive crowing of croup; but, as there was no heat of surface, or quickening of pulse, nothing was done. To-day it was considered prudent to apply two leeches to the back of the ear, and have the hair removed from the back part of the head, and the same plan of treatment as before was pursued.

"14th. There has been no return of the crowing cough, and the child's general health continues very good. She now evidently has regained some power in raising the arm; continue the mild diet; occasional doses of oleum ricini, lancing the gums, and the embrocation to the arm.

"21st. She daily acquires more the use of her arm. One of the teeth has come up to the surface, and the others are advancing.

"June 10th. She has nearly regained the complete power of her arm; her night cough is almost gone, and general health improving. The other teeth are not quite through yet; regularity of diet and attention to the bowels enjoined.

"August 20th. The child has been for some time in the country, and has perfectly recovered the use of her arm. The four teeth are quite through. Up to the present time she has never changed her diet in any way, taking bread and milk for breakfast and supper, and bread-pudding, with a single egg in it, for dinner. Her bowels are so regular that she has required no medicine for some time.—August 20th, 1835."

567. Before I conclude this subject, and that of diseases of the nervous system in *infants* and *children*, I must very briefly notice a *paralysis* of a different kind.

568. We frequently observe a *hemiplegic* paralysis from defective development of the opposite hemisphere of the cerebrum. (Sec § 150.) In this case *both arm* and *leg*, but chiefly the arm, are involved in the paralysis. But it occasionally happens that *one leg only* is affected with a *partial* paralysis; the limb does not *grow* as the other leg does, but remains thinner and shorter; yet it does grow, so that the paralysis is not complete, and it is moved, only with somewhat less power than the other leg. What is the nature of this partial paralysis? Is it of dental origin? Is it an affection of the spinal marrow, or of its nerves, equally partial? Cases, and careful examinations, are entirely wanting to determine these questions. I think this subject might be illustrated by the experiment of dividing the posterior, or *ganglionic* nerves of the spine, which proceed to the lower extremity in a very young animal. Sensation with *nutrition* would be lost, or impaired, whilst the muscular power would remain.

569. But sometimes the muscular power is entirely paralysed. You may compare the following interesting case of the son of my friend, Dr. Webster, of Dulwich, with one taken from Dr. Abercrombie's able work:—"When my boy was about twenty months old (he is now nine years) he had a fit of illness, connected with dentition, which threatened the brain, and for which I opened the jugular vein and purged him. This took him off his feet, and, very soon after, he had a fall from a rather high crib-bed; but this was not attended or followed by any apparent bad consequences. The child recovered his health; but for some weeks he seemed to have almost entirely lost the use of his legs, and, being uneasy about him, several of my medical friends saw him, among others, I think, yourself. He gradually, however, began to walk again, but

not so steadily as before, as he tottered much in his steps, and was constantly falling over every little object that happened to be in his way, and he had much less command over the left limb than the right. He seemed to walk on his toes. It was not at first ascertained that one leg was more affected than the other; but as he grew up and was breeched, the matter became more apparent; he plainly walked more firmly on the healthy limb, and less so on the lame one, and he threw it about more in walking and playing, and rarely set down the heel, except when walking slowly; never when running. He now runs on the toes of that foot, and with a sort of lurch; the limb is less firm; the muscular power is evidently less, but the sensibility seems equal to the other. I have only to add, that the affected limb is about an inch shorter than the other, which is the reason of his walking on the toes."

570. "It is now upwards of twenty years since I first saw a girl, aged, at that time, about eighteen months, and previously enjoying excellent health. She had been left for some time sitting upon damp grass, and was immediately seized with fever, accompanied by such a degree of oppression as led to an apprehension of an affection of the brain. These symptoms, however, passed off in a few days, and upon her recovery from them it was found that she was entirely paralytic in the right lower extremity. She has from that time enjoyed uninterrupted health, and is now a tall and strong young woman; but the right lower extremity has continued entirely paralytic; it is also a great deal smaller than the opposite extremity, and several inches shorter. All the joints are remarkably relaxed, and the muscles flaccid; but there is no other appearance of disease in any part of it, or in the spine."

In concluding this, I wish to advert once more to the subject noticed § 533.

There *is* such a case as paralysis of the pneumogastric nerve, and of the dilator muscles of the larynx; it occurs in deep intoxication, and probably in other cases of coma, as in that of apoplexy, of epilepsy from opium, &c.

A patient affected with such paralysis from deep intoxication was rescued from impending death by tracheotomy, at the suggestion of Mr. Sampson of Salisbury. The case is published in the "Medico-Chirurgical Transactions," vol. xx. p. 45, and forms one of the *most splendid achievements of modern Surgery*. I shall revert to it hereafter.

This interesting case contrasts painfully with a case of spasmodic contraction of the larynx, from a portion of food arrested in the upper part of the œsophagus, published by Mr. Kirby, in the "Dublin Hospital Reports," vol. ii., p. 225. Tracheotomy was here, also, performed, but it was too late.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, March 24th, 1838.]

LECTURE VIII.

THE NERVOUS SYSTEM AND ITS DISEASES IN ADULTS.—*Functions of the cerebral and of the excito-motory systems; anatomy of the spinal marrow; difficulty of detecting organic changes in the brain.* ENCEPHALITIS.—*Divisions and symptoms of the disease; explanation of its symptoms; morbid anatomy of meningitis; of myelitis; treatment.* CONGESTION AND CEREBRAL HÆMORRHAGE—*Symptoms; effect; treatment. Tubercles of the brain, and their symptoms. Scirrhus and encephaloid tumours. Hypertrophy and atrophy of the brain. Mania, its varieties and causes.*

GENTLEMEN:—Within the short space of one month I have seen five cases of *croup-like convulsion. All* have yielded to the remedies which I have described as being of such value in this disease, if only timely administered.

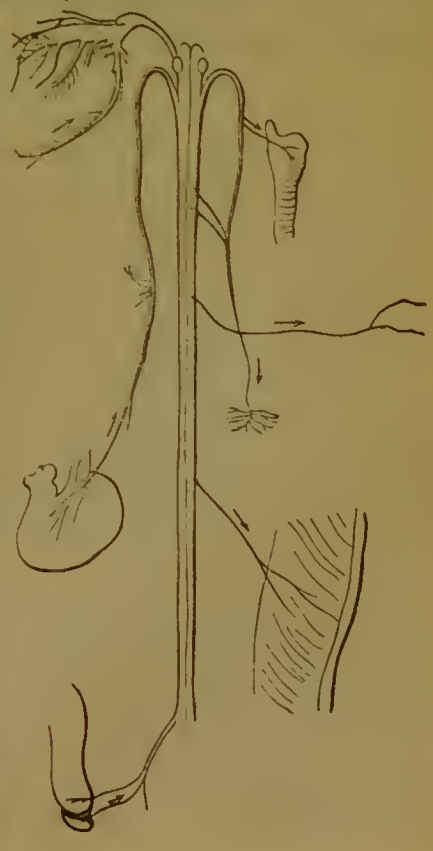
752. Three of these cases were of short duration. Strabismus, with *dysury*, in one, contracted fingers in another, foreboded the crowing inspiration. Both yielded to free and repeated scarification of the gums, and a strictly regulated diet, and state of the bowels.

753. In the *fourth* case it was feared that effusion had taken place into the ventricles. There were strabismus, a retracted head, a state almost of opisthotonos, contracted fingers and toes, attacks of fright, suspended respiration, obvious spasm of the muscles about the throat, and crowing. These fearful symptoms ceased on the most free and repeated scarification of the gums, a diet of asses' milk, and a free state of the bowels, with the tinctura hyoscyami.

754. In the *fifth* case there was obvious danger of asphyxia, contracted pupils during the paroxysms, and dilated pupils afterwards, and a state of emprosthotonos. A change of air suddenly removed the disease, which seemed to linger during the use of the other remedies. The case arose, apparently, from a state of torpor or constipation of the bowels.

Remember my remarks relative to the subject of teething, and of scarification of the gums, § 562, and let the former be observed accurately, and the latter employed in an efficient manner.

Allow me, in dismissing this interesting subject, to call your particular attention to the subjoined sketch:—



It *depicts* the *croup-like convulsion*. It represents to the *eye*, for the first time, the anatomical relations of the *causes*, and their immediate *effects* in this interesting disease. The *arrows* denote and distinguish the incident, excitor nerves, through which those causes act; and the reflex motor nerves, through which the final effects are induced upon the muscular system. It must be *studied*, for it affords much subject for reflection.

I now proceed to treat of

THE NERVOUS SYSTEM AND ITS DISEASES IN ADULT AGE.

755. From infantile to adult age the *cerebral* system undergoes a gradual and progressive development; many of the phenomena of the *true spinal* system are, consequently *obscured*. But, I repeat, these latter are only obscured; they are not enfeebled or diminished. In the close of life, the true spinal functions are as energetic and as essential as in its dawn. I have already pointed out the mistake of M. Lallemand in reference to this point. § 302.

756. The functions of the cerebral system —sensation, perception, judgment, volition, voluntary motion, § 302, are gradually developed from infancy to adult age. It is the ψυχη, the animus, the soul, enthroned on an organisation which becomes gradually more and more perfect. These functions are *psychical*. How different from those of the true spinal or mere excito-motory system. By the former we *feel* external impressions, *perceive* external objects, *judge* of their properties, *wish* and *will* to approach and avoid them, and actually *move* by a *voluntary* effort to or from them. By the latter, when an external object induces an appropriate action in certain muscles, its ingestion into the animal frame is effected or prevented, without any cognisance of our mind or will, although sometimes with such concurrence shown by additional voluntary acts. Thus, the atmospheric air is inspired, while carbonic acid is excluded, without any voluntary, cerebral, or psychical act; the sphincters still act when the organ through which the soul manifests its faculties is removed. How extraordinary that these distinctions have never been clearly demonstrated before.

757. The cerebral functions have an influence over those of the spinal marrow; some of these, as respiration, have, therefore, received the designation of *mixed* functions. The true view of this matter is that which I have just given. They are excito-motory. But volition has an influence over them. The passions, also, have a certain influence over the excito-motory and the ganglionic system of functions.

758. During *sleep* the cerebral functions are in a state of repose, but the true spinal functions continue in activity and energy. In *coma*, the true spinal functions become eventually more or less impaired.

759. The true spinal functions appear to be entirely of a *vital* kind, as distinguished from what is psychical or sensorial. They are excited by appropriate stimuli, and preside over the acts of ingestion and egestion. Nothing can be more marked than the distinction between them and the faculties of the soul to which I have just alluded.

760. I do not wish to press the metaphysical argument beyond its legitimate application; I may, however, add, that this is the only view of the subject according to which the *individuality* of the sentient being can be maintained. Does *one* sentient being, when divided, become *two*?

761. Leaving this argument out of the question, the view which I take of the subject is the only one which enables us to remove the difficulty experienced by Legallois already noticed. § 245.

762. If another argument were wanting upon this subject, it would be that afforded by the case of M. Brachet, already quoted, § 259, and other cases of a similar kind, in which sensation *was* actually annihilated; and yet the true spinal excito-motory functions *did* continue. It is preposterous to say there *is* sensation in such cases. The sphincters, &c., act, therefore, upon another principle.

763. In *every* determinate motion of an extremity, *two* principles of movement are called into action:—1. Volition; 2. The excito-motory power. One of them may be deranged, diminished, annihilated, without the other.

764. If I grasp a cane, volition begins, the excito-motory power completes, invigorates, the act. Already I have presented you, § 247, with the fact of a patient partially paralytic of the arm and hand, being able to close his hand upon a cane, although he was unable to do so without that excitant.

765. Dr. Little gives the case of a patient who had the perfect movements of the lower extremities, but, on placing one of his feet upon the ground, an excito-motory contraction of the gastrocnemius was produced, and his heel was raised involuntarily.

766. Suction in the aneucephalous fœtus is purely excito-motory; so is the action of the hand on placing an object in the palm; and it is this property which maintains the bird upon its wing, in its protracted flight, and the fish in the midst of the rapid stream.

767. Provision is made for these phenomena in the *anatomy*. The medulla oblongata is expanded on account of the many organs placed under its excito-motory influence. The enlargements of the medulla spinalis at the origin of the *brachial* and *crural* nerves, in some animals, are doubtless

destined for the same objects, and are more or less proportionate to the *quantity* of function, if I may use that term, in different species. These enlargements are so many moduses, as it were, of the true spinal system.

768. The force of muscular action in animals, is more in proportion to the violence of their *passions* than of their *volition*. Now, the passions act through the excito-motory system; this system is therefore proportionately developed. The carnivora have, consequently, a higher degree of ferocity, of muscular energy, and, probably, of true spinal development, than the herbivora.

769. In disease we have augmented or impaired volition, as in mania and in typhus; or of the excito-motory power, as in the effects of strychnine and of the hydrocyanic acid. What a vast field is open for cultivation.

770. In many diseases the influence of the excito-motory power, and of the passions, over acts of volition, is most obvious, as is also that of volition over the excito-motory power. Let the patient in chorea be directed to move his hand in a given manner; you will immediately observe the distorted movements produced by the disordered agency of the excito-motory power. Let the patient be agitated, his chorea is tenfold worse than before. The disordered actions of chorea are also aggravated by every act of the will; they subside, on the contrary, during sleep. I have this day seen a most distressing case of torticollis; when the patient is reposing, or asleep, the spasmodic action is greatly diminished; but, on every voluntary act, or motion of the body, and on any occasion of motion, the spasm is augmented exceedingly.

In certain cases, both sleep and passion seem alike to induce attacks of diseases of the excito-motory system,—as the croup-like convulsion in children, and of epilepsy in adults.

771. I must now observe that the phenomena of the excito-motory system like irritability, remain longer after decapitation, in very young animals, than in animals of adult age. This fact results from Legallois' observations.

772. I need not repeat that this able physiologist confounded the excito-motory function with sensibility. But, by interpreting his expression "of sensibility and voluntary motion," by that of excito-motory phenomena, his *facts* still remain, and are of great interest and importance.

773. Before I proceed any further with my account of the nervous system and its diseases in adult age, I will present you with a sketch of the arrangement of these diseases. I must first divide them, as I have done the nervous system itself (§ 3),

I. *The Cerebral, or Sentient and Voluntary;*
II. *The True Spinal, or the Excito-motory*; and
III. *The Ganglionic, the Nutrient, the Secretory, &c.*

774. In our subdivisions of these diseases we must still be guided by those of the nervous system, given at length, § 215, and § 219, to which I must beg to recal your particular attention.

I must also recal your attention to a remark which I made in a preceding lecture, § 250, in reference to a division of the diseases of the *true spinal* system into the *centric* and the *eccentric*. To these last a recent statement of M. Andral is extremely applicable.—"How small is the number of organic changes *known*, in comparison of that of the lesions of which we are ignorant. Those cases in which, after death, we find something appreciable by the scalpel are the most common in regard to the other organs; with respect to the nervous system it is very different. The cases in which we meet with appreciable lesions are the most rare. This assertion may appear paradoxical to those who are only acquainted with *the three or four diseases observed in hospitals*. In a multitude of cases affecting the sensibility, the movements, or the intelligence, we discovered no lesion, or none in proportion to these functional derangements."

775. Eccentric epilepsy, traumatic tetanus, hydrophobia, &c. &c., leave no unequivocal uniform traces under the scalpel. The morbid appearances which have been observed are not constant, but occasional, *effects* of the disease. I shall presently bring before you the observations of M. Gendrin especially upon this point. We must study the *anatomy*, the *physiology*, the *symptoms*; we must distinguish the centric from the eccentric forms of these diseases, —their *effects* from the diseases themselves; and we must add to these points the all-important one of the therapeutics,—the study of the *causes* and *prevention* of paroxysms, &c. We shall thus be supplied with all the evidence of which the case admits, and be preserved from the errors of those pathologists who think the gross and brute mass of the morbid anatomy is everything. We shall also be led to distinguish between curable and incurable forms of the same disease, or rather between different diseases unfortunately bearing the same name. I heard an amiable physician of Paris contend that epilepsy was invariably incurable. He did not distinguish the *centric* cases of that disease found in hospitals, workhouses, asylums, &c., from the *eccentric*, so frequently treated, and cured too, in private practice. For your own comfort, and for your patient's benefit, I beseech you to study these things with care.

It is interesting to observe how the pathology confirms the physiology and anatomy.

776. The *cerebral* diseases affect primarily the cerebral functions, and the true spinal functions consecutively. The diseases of the true spinal system induce changes in the excito-motory phenomena, in the first place, and in the cerebral functions, in the second. The cerebral diseases are generally more insidious in their progress than the true spinal, because slight aberrations of the cerebral functions are less observable than similar affections of the true spinal; pain, vertigo, watchfulness, &c., are less striking than the slightest degree of convulsive movement or paralytic affection. It is on this account that the *first* symptom *observed* in cerebral disease is frequently one belonging to the true spinal system, especially *vomiting*, perhaps *strabismus*.

777. The true spinal diseases, especially those of eccentric origin, affect, in a remarkable manner, the set of functions which I have noticed as belonging to this system: those of the eye and eyelid; those of the larynx, of the pharynx; the respiration; the action of the expulsors and of the sphincters; that of the muscles designated by the term *tone*. Revolve in your minds the symptoms of epilepsy, of hysteria, of tetanus, of hydrophobia; the causes and phenomena of vomiting, of asthma, of abortion, of tenesmus, and of strangury, and you will be forcibly struck with the justice of this remark. On the other hand, every convulsive effort affects the brain with congestion and its consequences, of which a fatal coma or effusion are not the least frequent.

778. I shall now proceed to describe the individual diseases of the nervous system, beginning with their *causes*, external and internal, and passing on to the *symptoms*, primary and secondary, in their relation to the different subdivisions of the nervous system, the *morbid anatomy*, and the remedies.

I.—Of Encephalitis.

779. Encephalitis must be distinguished into,—

1. *Inflammation of the Membranes.*
   - *a. Of the summit;*
   - *b. Of the ventricles;*
   - *c. Of the base;* and
2. *Inflammation of the Substance.*
   - *a. Of the principal divisions of the cerebrum;*
   - *b. Of the cerebellum.*

The former of these might be distinguished by the term *cerebral meningitis*, the latter by that of *cerebral myelitis*.

780. The *causes* of encephalitis are mechanical injuries of the head itself,—blows, falls, contre-coups; excessive mental application, anxiety, &c.; the intemperate use of spirits; exposure to the sun-beams, &c. Frequently encephalitis forms a complication of other diseases of the system, or of distant organs, especially fevers, the exanthemata, and dropsies. It is also frequently the *effect* of other diseases of the encephalon itself; it is excited round the coagulum, or cyst, in cases of cerebral hæmorrhage, tumours, tubercles, &c.; it is also sometimes excited by ossifications, or projecting spiculæ of tone. Meningitis and myelitis frequently excite each other. M Lallemand details a case in which a ligature applied to a part of the *right* brachial plexus induced inflammation and suppuration of the *posterior* part of the *left* hemisphere of the brain.

781. Encephalitis is said to have followed the suppression of the catamenia and other discharges. It is ever connected with rheumatism?

The *symptoms* of this disease first manifested are affections of the *cerebral* functions; affections of the *true spinal*, and of the *ganglionic* functions, follow in their turn. These symptoms vary much in the *first* and in the *later* stages of encephalitis.

782. The *very first* symptoms are affections of the sensibility,—the earliest, the most important, sometimes the *only* symptom, is *pain*, or cephalalgia; this is variously situated, not always acute, sometimes excruciating. In addition to pain, there is frequently intolerance of the eye to light, of the ear to sound, and occasionally of the skin to touch; to these are added the sense of flashes of light, or of sudden noise.

783. The *next* symptoms are affections of the mental faculties, sleeplessness, or disturbed sleep, restlessness, delirium,—sometimes violent—moroseness, stupor, unwillingness to be disturbed.

784. The *third* source of the symptoms is the volition,—there are various voluntary motions, denoting either pain or delirium.

785. Besides these affections of the voluntary movements, there are, in meningitis spasmodic movements; and in myelitis spasmodic, alternating with, or followed by paralytic affections, which strongly characterise these different forms of encephalitis.

786. The symptoms which belong to the *true spinal* system are very peculiar: the *first* of these is *vomiting*; this symptom should, therefore, never be neglected; the *second* is *strabismus*; the *third* is some decided *spasmodic*, or even *epileptic* attack.

787. The symptoms which belong to the *ganglionic* system are more obscure: the pulse is frequent; the bowels are frequently constipated, but the secretions are little affected.

788. It will assist your memory in reference to the symptoms of encephalitis, to bear in mind the arrangement of the cerebral and true spinal functions, which I have laid before you, § 4 and 153. I would have you *use* it, however, as Sydenham did his theories; that is, in such a manner that you can cast it from you, and give yourselves up

to pure observation, when you get into actual practice. Diseases *will not* suit themselves to our plans. Eucepbalitis, for example, is sometimes marked almost solely by violent delirium, and is then the *phrenitis* of unsologists; sometimes an early, if not the first, symptom is convulsion; sometimes there is violent headach, as the chief symptom. In other cases this disease is insidious in the highest degree; the patient seems *idle*; perhaps is suspected of *feigning*; he wout move or speak; and there may be *no* other marked symptom. Beware of these things. Cultivate an independent spirit of observation.

789. There is no symptom perfectly diagnostic of meningitis and myelitis. The former is more marked by acute pain, delirium, and convulsions; the latter by muscular coutractions, ulternating with, or followed by, paralysis.

790. The second stage of encephalitis is denoted by diminished sensibilities and mental faculties: the pain and delirium subside iuto insensibility, stupor, coma,—the spasmodic into paralytic affectinns. There may be bliudness, deafuess,—the pupils are geuerally incoutractile on exposure to light.

791. Eventually the true spinal functions suffer; there is permanent strabismus, difficulty in deglutition, stertor, and other affectious of the respiration; relaxation of the sphincters, &c.; the pulse varies much in frequency; the bowels are apt to be constipated; the urine is often scanty.

792. The insensibility of the patient frequently leads to a particular event; he is unconscions of the existence of a disease, which, under other circumstances, would induce great pain. Complicatious with encephalitis are, therefore, apt to be overlooked. One event I must point out to you in an especial mauuer; from insensibility the patient does not void the bladder; this viscus becomes excessively distended, and there may be a stillicidium urinæ; in *every* case of iusensibility, in *every* case of involuntary discharges of urine, examine the hypogastric region.

793. There is another *practical* fact of much importance, to which I must draw your attention; uot only the dawn and the course of eucephalitis are insidious, but its termination is particularly so. In some cases an unexpected state of *sinking* takes place, in which the symptoms, whether paiu or delirium, &c., subside, aud the patient is thought to be convalescent. The same eveut occurs iu some nther diseases, especially cuteritis. Beware of this fact, too, and suspect some such insidious change, unless *all* the symptoms concur to denote returning health.

794. The principal morbid appearances left by encephalitis are,—

In Meningitis.

1. *Injection.*
2. *Effusion of serum.*
3. *Effusion of lymph.*
4. *Effusion of pus.*
5. *Ulceration.*

In Myelitis.

1. *Injection; tumefaction.*
2. *Softening.*
3. *Purulent infiltration.*
4. *Abscess, encysted, unencysted.*
5. *Induration.*

795. These morbid appearances may take place in various parts of the encephalnn; those left by meningitis occupy the summit and the base of the brain and the ventricles; those induced by myelitis occupy the surface and the central parts, and any individual portiou, or portious, of the substance of the brain.

796. For further informatiou upon these important points I refer you, with great satisfactiou, to the works of M. Andral and Dr. Abercrombie. The only point to which I would draw your atteution particularly, is the fact that the inflamed brain is *tumefied*; this fact explains the occurrence of pressure, and its varied effects on different parts of the encephalon, frequently situated remotely from the part affected by inflammation, softening, &c. It is on this principle that we explain the occurrence of various affections of the true spinal system in inflammation of different parts of the cerebral system,—the strabismus, the vomiting, the various convulsions which occur in the early stage; and the stertor, the relaxed sphincters, &c., which occur in the later stages of encephalitis.

797. The *treatment* of encephalitis embraces bloodletting, general and local, purgatives, antimonials, mercurials, cnld lotions applied to the head, counter-irritation, &c.

798. The efficacy and safety of bloodlettiug depend upon its prompt and effectual admiuistration. I believe the *only* satisfactory mode of the institution of this important remedy is that which I have pointed out in my work on bloodletting. The patient is to be placed perfectly upright, looking upwards, and bled from a good orifice to *incipient syncope*. In this manner alone can we adapt the remedy to the nature and violence of the disease, and the strength of the patient. To *prescribe* a certaiu quantity of blood to be taken is a dangerous, indolent, and unjustifiable proceeding, for it is impossible to know, *a priori*, what that quantity should be.

799. This mode of instituting bloodletting also guards us against some terrible mistakes, and yields an important diagnosis. There are some diseases *so similar* to encephalitis, that the most experienced physicians cannot be absolutely certain what a given case may be. These cases would be

brought to a fatal issue if the same quantity of blood were withdrawn, as is both proper and necessary in encephalitis. Adopt the rule for bloodletting which I have proposed, and you will be saved from the danger of inefficient bloodletting in the case of inflammation, and of undue bloodletting in the other cases, so similar to it in appearance, yet so different from it in reality; you will also possess an accurate and important source of diagnosis. If it be inflammation, much blood will flow before the lip becomes pale; if it be of the other kind of disease to which I have alluded, such, for example, as delirium tremens, and certain congeneric affections, comparatively little blood will flow before that event occurs.

800. Topical bloodletting is appropriate in cases in which some symptom, or symptoms, remain, and we dare not deplete the system further.

801. Purgative medicines, especially the active purgatives, as the oleum croti tiglii, and nauseating doses of antimonials, are powerful auxiliaries to the other remedies.

802. The free exhibition of mercury, so as to affect the system, is distinctly useful in continued inflammatory affections of some serous and mucous membranes,—as pleuritis, peritonitis, croup; and they have been strongly recommended in encephalitis. I had recently a very interesting case, in which a state approaching to dementia, from meningitis, was cured by a long-continued mercurial course.

803. Ice, an alcoholic lotion applied to the head; the cold water douche, &c., are other powerful auxiliary remedies. The same remark may be applied to blisters, issues, or setons, applied on some convenient part of the head, or in the neck.

804. It is important that the head should be raised, that the feet should be fomented, and kept warm. It is important to prevent the patient's mind from being disturbed, or tried in any way; to keep the eye from the light, the ear from noises, &c.

805. I must in this place recal to your recollection the important remark made, § 357. The sudden attack of encephalitis, or it may be pleuritis, or peritonitis, after scarlatina, or rubeola, is fatal, unless it be promptly met by bloodletting in the erect position, to incipient syncope; in effecting which, an extraordinary quantity of blood is withdrawn. I owe much that I know of this affection to my friend Dr. Heming.

806. I was, a few weeks ago, called to a most interesting case at Highgate; a boy, aged 11, had had scarlatina in its slightest form sixteen days before; suddenly his face was *seen* to swell. He shortly became affected with appearances of *sinking*, and then with violent and almost continued *convulsions*, with coma, and dilated and incontractile pupils.

Wine and brandy had been given for the apparent sinking state.

What was to be done? Confiding in the protecting power of scarlatinous dropsy and of convulsion, I had him *bled* to ℥xxvii. from the jugular vein and arm. During the flow of blood the convulsions ceased, the pupils became contractile, and the little patient recognised his father.

From this time the internal remedies, leeches, aperients, &c., were all that were required.

II. On Congestion and Hæmorrhage in the Encephalon.

807. I now proceed to bring before you two diseases of the encephalon, certainly not less important, not less frequent, than encephalitis. They are apoplexy and paralysis, or more correctly,—

1. *Congestion without rupture*, and
2. *Hæmorrhage, or rupture.*

These affections, like encephalitis, may occur in—

1. *The membranes*;
2. *The substance of the brain.*

808. The causes of the attack of congestion, or hæmorrhage within the head, are predisposing and exciting; the former are plethora, repletion; or, on the contrary, exhaustion, inanition, or debility; disease of the heart, especially hypertrophy of the left side, without contracted aortic valves of the left side; some forms of acute anasarca; deranged or suppressed function of the kidneys; disease of the arteries, or veins, or other tissues within the cranium, &c. The exciting causes are excess in eating, muscular efforts, especially straining, vomiting, sneezing, the recumbent posture, &c.

809. As inflammation usually assumes an *acute* character, congestion and hæmorrhage are as generally *sudden* in their attack. There are frequently, however, certain *antecedent* symptoms, which denote the *threatening* of this attack, and which I shall take great pains to point out to you.

810. I would observe, too, that these antecedent symptoms can only be observed and learnt, like those of many other diseases, in *private* practice,—I had almost said in the cases of the rich and affluent,—by which I mean that it is in such cases that we are compelled, by our very office, to remain by the patient, watching, anxiously watching every shade of change.

811. These antecedent symptoms consist of headach, vertigo; a sense of pressure, a sense of confusion; incoherence, delirium; loss of consciousness, of memory; drowsiness; numbness, paralysis, spasm; giddiness, flashes of light, visual spectra, noises; pallor, sickness, vomiting; faintishness, &c.

812. These symptoms are all *cerebral*, with the exception of the vomiting and of the spasm; the relation of the former of these to

affections of the head has been already pointed out, but it cannot be insisted on too much. A fall on the head, inflammation, and other diseases of the encephalon, so frequently induce vomiting, as to make it a most valuable premonitory symptom in these cases.

813. The *attack* of congestion, or of hæmorrhage itself, is frequently of the most sudden kind. There is total loss of sense and motion; the patient is flushed, comatose, breathes with stertor, and the pulse is strong and full. This is probably the case of congestion. In the attack of considerable hæmorrhage, there are the symptoms of *shock* inflicted upon the nervous system; pain of the head is followed by paleness, sickness, and vomiting, and fainting; coma, or paralysis, loss of speech, or of the power of swallowing, succeed immediately, or more slowly, probably according to the promptitude or the extent of the hæmorrhage. In the attack of partial hæmorrhage, these symptoms are observed in a slighter form; and it is some paralysis, hemiplegia, partial loss of speech, &c., which ensues. In one interesting case, such an attack as I have last described was followed in a few months by one of severer form, and the patient survived but a few days.

814. It will be perceived that in these cases the true spinal system is affected in proportion to their gravity; to the loss of sense and voluntary motion are now added dysphagia, stertor, and relaxed sphincters; sometimes there are convulsions, sometimes contraction of the limbs; in other cases, as I have stated, sickness and vomiting.

815. The ganglionic system suffers in its turn; the bronchia and trachea become clogged with mucus.

816. The injection of inflammation is probably seated in the minute arteries and the capillaries, whilst the morbid anatomy, in these cases, consists in congestion or rupture of the minute veins and capillaries of the medullary substance of the brain. M. Serres speaks of a meningeal apoplexy; M. Cruveilhier depicts an "apoplexie capillaire" of the substance of the brain.

817. The meningeal rupture is both described and depicted by the late Dr. Cheyne, and by M. Serres.

The congestion of the substance of the brain is readily understood; it is not always obvious on post-mortem examination.

818. Rupture may occur in any part, and even in different parts of the brain, at once, or consecutively, and to any extent; it produces corresponding and proportionate effects: paralysis, partial or general, and coma, in their various forms and degrees.

819. Diffused meningeal apoplexy, extreme hæmorrhage, effusion into the substance, or into the ventricles of the brain, induce general paralysis, or coma; partial hæmorrhage of an hemisphere, paralysis of the opposite side of the body; still more partial and circumscribed hæmorrhage, may affect the arm, or the leg only, or the speech. (See particularly § 239.)

820. The appearance of cerebral hæmorrhage is very different at different periods after its occurrence: at first there is a mere coagulum of blood of various dimensions and form; afterwards, the colouring matter disappears, and fibrine, or serum, remains, enclosed in a cyst lined with a fine membrane, like the serous membranes; in some cases the sides of this cyst gradually approach each other, and remain in simple contact, or unite. The contents of the cyst sometimes become organised. The parts of the brain surrounding the hæmorrhage are frequently softened, sometimes as the *cause*, sometimes as the *effect* of the hæmorrhage; in old cases they are much indurated. The adjacent arteries are frequently diseased, beset with calculous or osseous matter, or affected with aneurysm.

821. The treatment of congestion and hæmorrhage of the encephalon, embraces the use of bloodletting, general and local, purgative medicines, the most rigid abstinence, &c. &c.

822. The principal point which I wish to impress upon your minds, in reference to bloodletting, is its different measure proper in mere congestion and actual rupture. In the former there is extreme tolerance of loss of blood; in the latter, the system is extremely, and even dangerously, susceptible of this loss. The diagnosis is frequently difficult. I have pointed out the most distinctive symptoms. In addition to an attention to these, I must impress upon your minds the importance of placing your patient in the perfectly upright posture before the blood is allowed to flow; watch his countenance, his breathing; keep your finger on his pulse, and the moment the slightest indication of approaching syncope takes place arrest the flow of blood and place your patient recumbent.

823. If early syncope occur, trust the future to local depletion by means of cupping to the occiput and the neck. If the patient lose a large quantity of blood without change, pursue and repeat the remedy boldly; his life depends upon ample depletion of the sanguiferous system: add to the energetic use of the lancet, that of the cupping instrument.

824. The head should be covered with a spirit lotion; the feet should be fomented, involved in ample bran poultices, and sinapisms alternately.

The bowels must be purged freely daily.

The diet must be mere barley-water.

The countenance, the respiration, the pulse, must, however, be watched, and the least disposition to debility cautiously noticed and remedied, even by stimulants, and especially by the carbonas ammoniæ.

825. The next questions relate to the treatment of the paralysis, should the patient survive, or escape, the attack of apoplexy. I must suppose all inflammatory action dissipated. In this case, liniments and electricity may be tried, but especially voluntary movements of the limb. Is strychnine ever of advantage?

826. Should not we rather be still contemplating the condition of the brain, and using the remedies proper for this cerebral disease, the source of the paralysis? Cupping, so as to induce irritation rather than withdraw blood, setons, issues near the part affected, that is, upon the hemisphere opposite to the paralysed side, are our principal remedies, but especially the first of these.

III.—Tubercles of the Encephalon.

827. Besides the diseases which I have hitherto mentioned, there are others which may occur in the encephalon; these are tubercles, and various kinds of tumours.

828. As inflammation, congestion, and rupture constitute the acute and sudden affections of the brain, tubercles and tumours present us with slow and gradually progressive diseases of this organ. Not that this rule is without exception, for inflammation is sometimes slow and insidious in its accession, whilst tumours occasionally produce the sudden attack of an apoplexy.

829. The difference between the same encroachment upon the cavity or contents of the cranium, formed promptly, or with extreme slowness, is enormous. Large tumours, slowly formed, may exist within the skull without a symptom; a clot of blood of the size of a pea, or certainly of a nut, in the substance of the brain, may produce hemiplegia.

830. In speaking of tubercles of the brain, I must allude to the important law discovered by M. Louis, in regard to tubercles:—that, beyond the age of fifteen, tubercles are never found in *any organ* of the body without being present in the *lungs*. In a doubtful case, then, we examine the condition of the thorax; if there be tubercles there, it is a presumption that there may be tubercles in the encephalon; if there be no sign of pulmonary tubercle, it is a presumption that the affection of the brain is not tuberculous. But, as pulmonary tubercles are not always easily detectable, we endeavour to ascertain, in the absence of signs, whether there be other reasons for suspecting tuberculous formation,—such as an hereditary strumous or tuberculous disposition, the general or local signs of tuberculous affection in the system, or in any organ, &c. Otherwise the symptoms of tuberculous affection of the brain are not different from those of slow inflammation.

831. Tubercles occur principally in the cortical and medullary substance of the upper part of the hemispheres; but also in the cerebellum, tuber annulare, medulla oblongata, and spinalis; and in the peduncles, the corpora striata, and the thalami. They vary from the size of a millet-seed to that of a pea or of an egg; they sometimes become encysted, especially as softening takes place; they frequently excite increased and inflammatory action in the adjacent portions of the nervous mass, whence the symptoms.

IV.—Tumours of the Encephalon.

832. Tumours, and especially the scirroid and encephaloid, may exist within the cranium; they have occasionally followed blows on the head; they frequently co-exist with other similar affections in other organs of the body.

833. Developed slowly, they may exist with scarcely any symptom, or they may induce symptoms, on the principle—(1) of compression; (2) of irritation; and (3) of inflammatory action in the adjacent parts, of the brain, nerves, membranes, and the cranium itself. These symptoms are frequently induced gradually; sometimes suddenly; and are varied with the part principally affected. They consist of pain, followed, perhaps, by stupor; loss of smell, sight, touch, hearing, or taste; paralysis, or various convulsive affections, as strabismus, or even *epilepsy*.

V.—Hypertrophy of the Brain.

834. This disease has only been recently distinguished from other diseases of the encephalon. We owe our knowledge of it principally to MM. Bouillaud, Dance, Scoutetten, and Andral. It has sometimes occurred in children; but most frequently between the ages of twenty and thirty.

825. The brain is at once larger and paler than natural. In this latter particular it differs from inflammation or congestion, in which there is also a degree of tumefaction. On opening the cranium, the dura mater seems ready to burst; on removing this membrane, the convolutions of the brain are so firmly pressed together that the intervening triangular spaces have disappeared.

836. The symptoms are those induced by compression: after long-continued pain, loss of intelligence, and muscular power; convulsions, epilepsy.

837. In one case only were these symptoms absent; it was the case of Scoutetten, which occurred in a little child aged five, in whom the cranium grew, *pari passu*, with the augmented size of the brain. This fact has been already noticed. § 272.

VI.—Atrophy of the Brain.

838. I have already alluded to the congenital atrophy of the brain, § 293. In this place I simply notice a fact which should not be unknown to you, that the brain some-

times becomes atrophied in some part, especially of the convolutions, in the later or latest periods of life. Dementia and paralysis are the effects of this singular malady. Frequently the patient becomes utterly helpless, and passes into *second childhood*, as it is termed, the evacuations passing involuntarily.

839. Sometimes the convolutions are simply reduced in volume; at other times they are puckered; in other cases there is induration.

840. The patient lives a life of a mere excito-motory and nutritive kind. The cerebral functions are obliterated; the true spinal and ganglionic functions alone remain.

841. There is much for the physiologist and pathologist to investigate in this singular *return* to a sort of infantile existence.

VII.—Of Mania.

842. There is still much obscurity in our views of this sad but interesting subject.

The most important consideration in regard to the *causes* of mania is, undoubtedly, hereditary predisposition.

843. The most powerful of exciting causes is mental harass; the arduous duties of our prime ministers, the anxieties of the Stock Exchange, have frequently led to mania in its worst forms. Another set of causes of mania are the circumstances involved in the parturient and puerperal states, whether these be shock of the system, intestinal irritation, the loss of blood, the establishment of lactation, the condition of the uterine system, &c. I have had the most unequivocal evidence of the influence of loss of blood in inducing mania under other circumstances. For a case of this kind I may refer to the "Medical Gazette," vol. ix., p. 421. Protracted lactation is also an undoubted cause of mania. A very morbid condition of the bowels also indubitably leads to mental derangement, hence the term melancholia.

844. Mania, when it does occur, assumes various forms; it is sometimes attended by an expression of the eye and of the countenance, a manner, a demeanour, a loquacity, which denote the utmost excitement; in other cases it is moping, melancholy, with a corresponding attitude and taciturnity; in a third instance there is a monomaniacal disposition to suicide or homicide; in a fourth patient we may have nymphomania.

845. The first symptom is frequently wakefulness. Never neglect this symptom; it is so frequently the prelude to inflammatory or maniacal affections that it should always be treated with extreme attention.

846. Then some incoherent idea is expressed; love is changed into hatred; friends are viewed as enemies; prosperity as ruin; there are suspicions of a thousand kinds; despondency, or absolute despair, &c.

847. Some such expression will excite your attention to the impending evil, and then you will proceed to ascertain its particular cause, or causes, its forms, &c.

848. An important question is that which relates to the morbid anatomy: is this *cause* an *effect* of mania? That it is frequently the effect, and that it has been as exclusively regarded as the cause, I can scarcely doubt. The appearances are usually deposits of serum and of lymph between the arachnoid and pia mater, sometimes effusion into the ventricles, sometimes injection of the cortical substance.

849. In protracted cases these effects may be more considerable still, and lead to dementia, general paralysis, &c. You may consult M. Calmeil's interesting volume upon this subject.

850. If encephalitis is the frequent effect of mental harass and effort, why may not these appearances be the effect of the maniacal state?

851. This question is an important one. If the view at which I venture to hint,—if mania be the *cause* of the morbid appearances,—our hopes are excited; if it be the effect, our fears are confirmed. Indeed, I have always observed that certain facts, such as the inveteracy of the case, a peculiar effect on the countenance, the manner, &c., lead to the formation of an unfavourable prognosis, and, I believe, because they denote the *supervention* of morbid changes in the encephalon.

852. Why is the *moral* treatment so important? It is surely because it diminishes the violence of the maniacal condition, and so obviates its tendency to produce such morbid changes of structure, with its consequent hopelessness.

853. Why is it so important to procure quiet composed sleep? Obviously for the same reason. Sleeplessness, like mental effort and the maniacal paroxysm, may induce morbid actions in the encephalon, and these may lead to morbid changes.

854. The evidence from the morbid anatomy is quite deficient for practical purposes unless we are enabled thus to distinguish cause and effect; and I fear this point has not been sufficiently considered by those who have addicted themselves to this department of medical science. It is sad to observe how a little effusion, a slight layer of lymph, is the *cause* of everything in the minds of some of these gentlemen of one idea.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, March 24th, 1838.]

LECTURE IX.

THE NERVOUS SYSTEM.—*Paraplegia and hemiplegia. Diseases of the cerebellum. Opinions of M. Serres. Cerebral affections arising from intestinal irritation. Exhaustion from loss of blood. Chlorosis; examples of fatal termination of this disease. Effects of mental and physical shock; delerium traumaticum. The effects of alcohol. Dropsies. Paralysis of the sentient nerves. Experiments on the nerves of taste. Further remarks on the croup-like convulsion.*

GENTLEMEN:—In a subsequent part of these observations, I shall have to treat very particularly of the condition of the lower limbs in *paraplegia:* before I proceed to the proper subject of this lecture, I must call your attention to a similar point, viz., the condition of the upper and lower extremity, but especially of the former, in *hemiplegia.* In hemiplegia we have to trace the effect of the passions, of continued *direct* excito-motory or spinal action, in the absence of the influences of volition, with the effects of certain remedies, as strychnine. In paraplegia, we are called upon to observe the influence of the *reflex* excito-motory power, through the medium of the incident, excitor nerves, the true spinal marrow, and the reflex motor nerves.

855. The *arm*, in hemiplegia, recovers much more slowly, much more imperfectly, than the leg. What is the rationale of this fact? In *old* cases of hemiplegia, the arm and hand become much contracted. What is the rationale of this phenomenon?

856. In the first place, I must remark, that the fact which I published in a former lecture, see § 290, has been confirmed by observation in a considerable number of patients. In one case of hemiplegia, of three years' duration, in a medical gentleman, the arm was extremely paralytic, the lower extremity less so: the arm was most susceptible of the galvanic influence, the leg less so; the limbs unaffected by paralysis least so of all.

857. I have already made some observations upon the seat and influence of *the emotions and passions* (§ 201—206), and upon the nature of *tone* in the muscular system (§ 197—200). I have only farther to observe upon these points, that in hemiplegia the passions are *seen* to act on the paralytic arm and leg, because their influence is uncontrolled by volition. The reason why the hemiplegic arm and hand become contracted, is, that the excito-motory principle of tone is continually acting—acting more forcibly upon the flexors, which have greater power than the extensors,—unmitigated by acts of of volition. The reason why the hemiplegic leg recovers its power of moving sooner than the arm, is that volition (the acts of which and not strychnine or galvanism, which act upon another *system*), is its natural *remedy.* The hemiplegic leg is continually moved, of necessity, recovers its voluntary power, and does not become contracted. The hemiplegic arm is left out of use, subjected to the coustant influence of the direct excito-motory power, and so contracted.

858. Is not this an interesting view of the subject? And what do you think of the *philosophy* of giving strychnine, which acts on the true spinal, or excito-motory system and power—already too active—to *cure* hemiplegia, which is a disease of another power, seated in another system, the cerebral, the system of the volition? And what do you think of those *judges!* and *critics!* who have attempted to throw discredit upon the discovery which *alone* can explain all those things? Especially with what ineffable contempt must you look upon the recent coarse and malignant remarks in the "Medical Gazette;"—remarks which are disgraceful, by their ungentlemanly style, both to our *literature* and to our *profession.*

Surprised indeed should I be to see discovery originate in such minds. When persons write *anonymously*, especially, they should write truthfully and justly, and with *some degree* of urbanity.

859. But I proceed with my lecture. I must now make a very few remarks upon

VIII.—Diseases of the Cerebellum.

860. The experiments of M. Flourens, the experiments and clinical observations of M. Serres, and similar observations by M. Andral, are the principal sources of our knowledge upon this subject.

861. M. Flourens considers the cerebellum to be the organ of equilibrium in the movements of the animal frame, judging from experiments of the most interesting character.

862. M. Serres' opinion is that of Dr. Gall, founded upon new experiments and cases, that the cerebellum, and especially its median lobe, is the excitor of the genital organs. I think neither these experiments nor cases sufficiently *isolate* the cerebellum from the medulla oblongata. The median lobe of the cerebellum can scarcely be diseased without affecting the adjacent medulla. And the experiments seem also to have involved an injury of that part of the nervous system, as you may judge from the following extract:—

"In oxen, knocked down by a blow upon the occiput, I have found," says M. Serres, "the cerebellum torn in its superior part, in those in which the penis had presented during the experiment, decided occillatory movements.

863. "In a stallion whose leg had been crushed by a carriage, an amputating knife plunged into the median lobe of the cerebellum, as far as the upper part of the *medulla spinalis*, induced a very decided erection.

864. "But this result has especially been obtained since the publication of these facts by one of our most able experimentors, M. Segalas.

"865. "If, in a guinea pig," says this physiologist, "we lay bare the cerebrum, and plunge a probe into the cerebellum, *so as to arrive at the superior part of the spinal marrow*, we induce *erection;* if we then push the probe down the spinal canal, as far as the lumbar vertebræ, we induce *ejaculation*, whilst the bladder remains full as before. The same results are obtained, if, in a decapitated guinea-pig, the spinal marrow be destroyed in the same manner.

866. "This last experiment, which I have repeated, and the correctness of which any one may assure himself, proves two things: the first, that irritation of the *cerebellum (?)* induces erection; the second, that irritation of the inferior part of the spinal marrow induces erection, and that the latter acts especially on the secreting organs of the semen."—("Anatomie du Cerveau, t. ii., p. 605—606.)

M. Andral observes,—"In the 36 cases which we are analysing we have only thrice noticed the genital organs. In one case there was permanent erection of the penis. There was in *one* of these cases compression of the right lobe of the cerebellum, *and* on the medulla oblongata, by a tuberculous mass. The case was taken by Dr. Sorlin, and published in the "Thesis" of M. Léveillé.—("Op. cit. t. v. p. 736.)

867. The late Mr. Earle observed, in a note which I received from him, "I have never met with any case in which priapism took place, except when the *cervical* spine was the seat of the injury. Whenever the upper cervical vertebræ have been injured priapism has almost invariably occurred immediately after the injury."

868. Diseases of the cerebellum, when they induce paralysis, usually affect the *opposite* side of the body, and the inferior more than the superior extremities.

869. Convulsions are more frequent in diseases of the cerebellum than paralysis. They affect many parts, and resemble epilepsy, or only one part. There can be little doubt that it is the adjacent medulla oblongata which is really irritated so as to produce these phenomena.

870. In some instances there has been a loss of balance, such as occurs in intoxication.

Sometimes the sensibility has been affected,—exalted or impaired. In some cases there has been amaurosis.

871. Vomiting sometimes occurs as a prominent symptom, as in many other diseases of the encephalon. This, as well as the affections of the genital organs, is obviously a result of irritation of the medulla.

To convince you that diseases of the *median* lobe of the cerebellum must affect the medulla oblongata, I here present you with a sketch of a clot of blood which was poured out in the space between these two organs:—

a, cerebel.—*b* medul.—*c* clot.

872. The medulla oblongata being *suddenly* compressed, the respiration ceased, and the patient expired instantly. I am indebted for this interesting case to Mr. Kiernan. An organic change which would have produced irritation rather than pressure, would have induced a very different effect.

873 I now wish to draw your attention to a series of morbid affections which result from peculiar affections of the general system, or of various organs. They have been too much neglected by writers on diseases of the encephalon.

They may be designated—

CEREBRAL DISEASES RESULTING FROM VARIOUS AFFECTIONS OF THE SYSTEM;

and they may be arranged thus:—

I. *Intestinal irritation.*
II. *Exhaustion from loss of blood.*
III. *Chlorosis.*
IV. *Excessive study, shock, alcohol, &c.*
  a. *Delirium tremens,*
  b. *Delirium traumaticum.*
V. *Affections of the kidney.*
  a. *Dropsy.*
  b. *Diabetes.*
  c. *Other morbid affections of the urine.*
  d. *Ischuria.*

874. Several of these affections are not seen in hospitals; it is in private practice only that we become acquainted with them. They are, also, almost neglected by writers on diseases of the brain; yet it is impossible that you should be prepared for practice without a due knowledge of these diseases.

I.—INTESTINAL IRRITATION.

875. The first of these affections consists of the irritation of indigestible food, scybala, or other morbid contents of the stomach, or bowels, excited into activity by some shock of the system, or of the nervous system, such as a fall, or other accident, parturition, &c.

876. The symptoms are, rigor, frequently severe heat of surface, and violent pain of the head, and intolerance of light and of sound; the symptoms, in a word, of the most acute encephalitis.

877. The breath is tainted, the tongue loaded and swollen, the secretions morbid; but it would still be difficult to establish a distinct and confident diagnosis without the criterion afforded by the effect of bloodletting in the erect posture, of which I shall speak presently.

878. The first step to be taken in a doubtful case, is very slowly to administer an enema of from three to three and a half pints of warm water, and to examine the state of the fæces, and observe the effect upon the disease and upon the system. If there be scybala, if the symptoms be subdued, and especially if there be faintishness, the case is indubitably not cerebral inflammation but intestinal irritation.

879. If the case still remain doubtful, prepare the arm, open a vein, and then place the patient upright, and let the blood flow until the lips become pallid; if the case be encephalitis, an extreme quantity of blood will flow, even thirty or forty ounces, or more, before there is any appearance of syncope; if it be intestinal irritation, syncope occurs before one-fourth of that quantity of blood has left the circulating system.

880. I have insisted so much upon the importance of a knowledge of this disease, and upon the nature of this diagnostic and guard against the undue and inefficient bloodletting, in several works, that I shall merely refer you to them for further information, which it would occupy me too long to repeat on this occasion.

881. This affection sometimes assumes a far less acute form. I met with such a case very recently; it had been mistaken for encephalitis. The patient slowly but perfectly recovered from attacks of vertigo, &c., by maintaining a regular state of the bowels, diet, rest, and afterwards of gentle exercise, change of air, &c.

II.—EXHAUSTION FROM LOSS OF BLOOD.

882. I must refer you to the same works for information on this important subject.

Throbbing, pain of some part of the head, a sense of pressure, as of an iron nail, of an iron hoop; intolerance of sound, of disturbance; sleeplessness; a state bordering on delirium; actual delirium, or even mania; some convulsive affection, perhaps epilepsy itself, are the affections which most frequently result from loss of blood.

In other cases there are amaurosis, deafness, paralysis, a state of dozing, or slight coma,—the apoplexia ab inanitione.

883. There are some observations upon this subject in a recent volume of the "Medico-Chirurgical Transactions," by Sir B. Brodie; some time after an injury of the head it became doubtful whether the symptoms depended upon the original accident, or upon the treatment. The plan was changed, and the patient recovered. In the "Medical Gazette" there is an interesting case of *amaurosis* from loss of blood, by Professor Badham, of Glasgow, occurring in his own daughter. I believe there was much obscurity in the case until the Professor was shown my work upon the effects of loss of blood.

884. I have known such cases treated upon antiphlogistic principles, until there was the most imminent danger, when a change of plan has immediately induced a favourable change, and eventually restored the patient.

885. Gentle stimulants, such as small quantities of brandy, the carbonate of ammonia, chalybeates, and a mild animal diet, are the principal remedies in such cases.

886. I will conclude these brief remarks by observing, that the first series of symptoms are entirely cerebral; those observed late in the disease coujoin with cerebral symptoms, symptoms which belong to the true spinal system; the half-closed eyelid, a degree of stertor, au uncertain state of the sphiucter, convulsion, are of this character. Eventually, in the very last stage, the ganglionic system suffers; mucus accumulates iu the bronchia, and serum in the air-cells, and cellular substance of the lungs; and flatus distends the intestines.

887. After death effusion is found to have taken place under the arachuoid, at the surface and base of the brain, and iuto the veutricles; there is œdema of the lungs, the iutestine, &c.

III.—On Chlorosis.

888. The influence of the state of bloodlessness which occurs in chlorosis, upon the eucephalon, has not been duly noticed by practical writers; I shall, therefore, mention this subject a little more in detail than some others.

889. I have, within the last eight years, seen four cases of fatnl chlorosis. The fatal eveut took place in one case suddenly; the patient was seized, quite unexpectedly, with the symptoms of dissolution, whilst sitting up for a few minutes in a chair, when iu a state of apparent convalescence from a feverish cold, and speedily expired. In the second case a feverish cold led to the symptoms of a more gradual sinking. Iu the third, fever, cough, and aphthæ, followed parturitiou, aud issued in the sinking state. The fourth and last case issued, in the most insidious manner, in a series of symptoms of an equally insidious sinking of the vital powers.

890. Of the second and third cases no post mortem examiuation could be obtained. Iu reference to the first aud last, and especially the last, I was more successful in my eutreaties to obtain this satisfactory elucidation of the nature of disease.

891. Miss H***, aged eighteen, was well, with the exception of a little eonstipation, when she went to school at Boulogne, in 1828, aged thirteen.

892. She remained a year, and returned home. She went again in six weeks, and remained nnother year; and, during this year, the catamenia did not appear, and the bowels were constipated. On her return she looked pale, but she was stout, nnd grown, lively, and in good spirits.

A fortnight after her return, the eatamenia appeared, but they were pale and scanty; the bowels were constipated.

She coutinued pretty well until July, 1833, when shc became sallow, pale, affected with pain of the head, and shortness of breath, nnd coldness and dampness nbout her persou; the catamenia gradually diminished in quantity and colour; the bowels were constipated, and she became fond of concealing and eating dry rice, coffee, and tea-leaves.

893. About a year ago the paleness was augmented, and the ankles began to swell; leeches were applied to the temples.

During the last summer the paleness augmented still further, and the œdema assumed the character of anasarca; the perspiration became offensive; the catamenia were scanty, pale, and yellowish, or greenish, and varying much in colour, but never red.

894. December 13, 1834.—I saw Miss H*** seven days ago; the eountenance was pnle, and slightly œdematous; the legs anasarcous; the head affected with mild delirium, with a degree of intolerance of light nnd noise; the breathing wns hurried, and rather audible and rattling, with cough; the pulse 130, and throbbiug; the abdomeu tumid.

895. These symptoms continued; at first there was delirium, afterwards there were dozing and slight coma; afterwards the mind was clear; at length the coma returned; the respiration became momentarily suspended, nnd the inspiration sudden, and sometimes *catching*; the abdomen became decidedly tympanitic, with the escape of much flatus; the pulse continued at 130, and sometimes 140, with fullness and throbbing.

The strength gradually declined, and dissolution took place rather suddenly, after the free evacuation of the bowels.

896. On examination, there was effusion of sernm and of opaque lymph under the arachnoid, at the summit and base of the brain; there was an effusion of six draehms of serum into each ventricle.

The summit of each luug was extremely pale, œdematous, and crepitant between the fingers; large portions of foaming lymph exuded from incisions made into them; the root of each lung was red, not crepitant, and sank in water; and, on making incisions, much fluid exuded without *foam*, or bubbles of air. The bronchia were injected; each cavity of the thorax contained five or six ounces of serum, and the pericardium one ounce; the heart was natural.

The viscera of the abdomen, except the ovarin, were natural, but pale; there was no effusion; the tympanitis had disappeared. The ovaria were large, and one of them contnined a cyst replete with serum, of the size of a lnrge walnut.

897. There was eonsiderable adipose substance.

This case is important in every point of view. It is important in regard to the nature of the disease, of which it is an example, demonstrating, as it does, the tendency of thnt disease to induce, not merely external dropsy, but effusion under the arachnoid, aud into the pleura, the pul-

monary cellular membrane, &c. It is important, too, as an unequivocal representation of the disposition to such organic changes in cases of bloodlessness and exhaustion. It is also important, as establishing the fact that not only serous effusion, but the deposit of coagulable lymph, may take place, without inflammatory action, in similar circumstances, and that, consequently, such deposit of lymph is no proof of inflammation.

898. In a recent fatal case of delirium tremens, serum was found effused under the arachnoid, and into the ventricles, whilst opaque lymph was deposited under that membrane. Similar appearances observed in chlorosis enable us to say that such an appearance cannot be adduced in proof of inflammatory action; for no one can imagine that the appearances which have been detailed, as observed in chlorosis, can be any other than the peculiar effects of this disease, or that the deposit of lymph under the arachnoid can depend upon any cause different from that which induced the effusion of serum under this membrane, and from the pleura, and the pulmonary and cutaneous cellular membranes.

899. I need scarcely add the remark, that chlorosis must not be viewed as totally free from danger. When anasarca has supervened to great pallor, there is the fear of effusion into the encephalon, and of a fatal result, which is sometimes of the most insidious, sometimes of the most sudden kind.

IV.—Of Shock, Mental and Physical.

900. The immediate result of shock on the general system, but especially on the cerebral system, is of the most interesting character.

The influence of *mental* shock is frequently a state bordering on delirium, or mania. Suicide is a frequent event at such a moment. There are a sense of weight, or pain, about the head, and sleeplessness. There is great danger of mistaking the symptoms for mere mental affliction; we ought to *treat* it as a serious malady. The timely use of the lancet would have prevented many an act of suicide. But I will illustrate this point by a most interesting case:—

901. A. B——, aged forty, became ruined in character and fortune, and, when in the midst of his difficulties, experienced a sense of heaviness and pressure in the head, and passed sleepless nights. After several days he attempted suicide, by dividing the muscles and blood vessels of the arm deeply. He lost a large quantity of blood, and became faint. On recovering from this state he said to his medical friend,—"Had you bled me a few days ago I should not have done this act; my feelings are altered, and I regard suicide with abhorrence; had Sir Samuel Romilly been timely bled, he had still been alive." From this time all the symptoms subsided.

902. To the same *class* of affections, doubtless, belongs the nervous delirium, or *delirium traumaticum*, described by Dupuytren, as following serious accidents and operations.

903. There are sleeplessness, delirium, jactitation; the eyes are injected, the countenance flushed and animated; the forehead covered with profuse perspiration; the patient is insensible to the pain of his accident, or operation; there is no fever or constipation.

904. This affection is frequent after attempts at suicide.

The patient may fall asleep, awake composed and rational, relapse, &c. It is a short mania for five or six days; it is attended by great danger.

There are no distinct traces of morbid change on examination. The brain and spinal marrow are found apparently healthy.

The remedy recommended by Dupuytren is a small enema, with five or six drops of tinctura opii, repeated three or four times, at intervals of six hours.

V.—The Effects of Alcohol.

905. These cases are obviously allied to *delirium tremens*, the result of drinking spirituous liquors. In this case there are wakefulness, delirium, and tremor, singularly combined.

The symptoms of delirium tremens may occur during the habit of taking alcoholic liquors, or immediately after the wonted stimulus is withdrawn.

906. The first symptom is tremor; this leads to sleeplessness, and this to delirium; the delirium frequently consists in the imagined presence of objects, which the patient is anxious to seize or to avoid. The tongue is white; the breath tainted; the surface moist; the pulse becomes frequent.

In the advanced stage, the delirium may be replaced by coma, the tremor pass into subsultus tendinum, the evacuations become involuntary.

907. The attack of delirium tremens is very apt to recur. The first attack is rarely fatal, but a subsequent attack may terminate unfavourably.

The morbid appearances observed, usually after the second attack, are the effusion of serum into the ventricles, and of serum, and even of lymph, under the arachnoid.

908. I have known free bloodletting induce a degree of sinking, both in young and old, from which no means could restore the patient. Opium, with a strict attention to the diet, and to the secretions, constitutes the most efficacious remedy. It becomes a serious question whether any stimuli should be allowed.

909. There is an interesting fact in the "Précis d'Anatomic Pathologique" of M. Andral, t. ii., p. 770, illustrative of this latter question: A drunkard is cast into prison, and put upon prison diet, becomes affected with delirium, is allowed a certain portion of spirit and water, and immediately recovers.

910. The three affections which I have just briefly brought under your notice, highly merit your best attention.

I now pass on to two others of a very different character; the first of these is a cerebral affection, which is apt to occur in the course of some

VI.—Dropsies.

911. Dr. Wells, of *St. Thomas's Hospital*, was amongst the first to draw the attention of the profession to the frequent presence of albumen in the urine of patients affected with dropsies, preceded or unpreceded by scarlatina, in two most admirable papers published in the "Transactions of a Society for Promoting Medical and Surgical Knowledge," vol. iii., p. 167, and p. 147. Dr. Wells's observations have been amply confirmed by Dr. Blackall, Dr. Bright, &c.

912. In the midst of such a disease the patient is not unfrequently attacked with symptoms denoting a cerebral or true spinal affection. There are delirium, or coma, or convulsions, apoplexy, or meningitis.

913. I have already more than once alluded to such an affection in children. Dr. Wells mentions this affection, p. 177; Dr. Bright gives such a case in his "Medical Reports," vol. i., p. 97; there was, in this last case, "a slight serous effusion under the arachnoid." The subject is in need of renewed investigation.

In diabetes and other morbid states of the urine, cerebral affections are apt to supervene.

VII.—Ischuria.

914. The next disease to which I must refer you as intimately connected with the brain, is ischuria, or suppression of the urine, to which may be added other morbid conditions of this secretion, besides that marked by the presence of albumen. Dr. Prout, Dr. Abercrombie, and Dr. Wilson, have lately treated this subject.

915. There is frequently considerable disease of the kidneys. The suppression may be partial or complete; it leads to fever, thirst, a urinous taste in the mouth, and smell of the perspiration, nausea, vomiting, hiccup, delirium, coma, convulsions.

916. It was necessary that I should enter into these brief details; otherwise the sketch of my subject would have been incomplete. When the whole outline is filled up I flatter myself that it will present a work of great *practical* as well as scientific interest, and I trust that I shall be enabled to accomplish this before many years have passed away. I now proceed to give you some account of the morbid affections of the cerebral nerves.

917. I now preceed to treat of the

Diseases of the Cerebral Nerves.

918. In treating of the diseases of the cerebral nerves I must beg you to refer to the arrangement of these nerves formerly laid before you, and especially to remember that they are divided into *sentient* and *voluntary*.

I.—On Paralysis of the Sentient Nerves.

919. In an interesting case of a tumour, found at the anterior part of the base of the brain, the *olfactory* and *optic* nerves were destroyed, and with them the sense of smell and vision.

920. The *optic* nerve may be subjected to compression or disease in any part of its course, from its origin to its termination in the retina itself. In one case a partial loss of vision coincided with strabismus, the defective eye being drawn inwards; in another, there were, at the same time, defective vision, and a spasmodic affection of the *seventh* of the same side.

921. Amaurosis may occur in affections of the brain; it is frequent in hydrocephalus; rare in paralysis; it occurs, as I have already stated, from extreme loss of blood.

922. I have already adverted to the difference between the case of paralysis of sensation of the face in hemiplegia, or from division of the *fifth* in a part of its course *exterior* to the cranium, and that arising from the division or disorganisation of this nerve *within* the cranium. In the first two cases the eye is unaffected; in the last, this organ gradually perishes, as I imagine, from the destruction of its ganglionic or nutritive nerve.

923. This extraordinary fact was first ascertained by M. Magendie in experiments; it was then observed in the human subject by M. Serres; it has since been witnessed by Dr. Alison, Mr. Stanley, and other observers.

924. In M. Serres case, the right eye and the right nostril were insensible; the left sensible; the gums scorbutic. On examination the origin of the *fifth* pair of nerves on the right side of the tuber annulare was found diseased.

925. Paralysis of the *fifth* pair, in its exterior course, was first distinctly pointed out by Signor Bellingeri, in Italy, and afterwards by Sir Charles Bell, in this country. The former of these writers has published a case, in his "Dissertatio Inauguralis," 1818, of paralysis, I think, of the *fifth* and of the *seventh* nerves. The precise nature of the case is not, however, certainly known, the patient having happily recovered.

926. The most interesting case of this

kind, which it has ever been my lot to witness, was that of Ruth Peters, aged sixty, who was repeatedly seen by my pupils during the last session; this person was taken with pain of the right temple, deafness of the right ear, partial paralysis of motion, and of sensation on the right side of the face, the right eyelid being only slightly depressed on attempting to shut the eyes, and the mouth being drawn to the opposite side. These symptoms continued, and in three months precisely similar events occurred on the left side, in a severer form, the mouth being drawn to the right.

927. These phenomena continued for a very considerable period. At length *this* portion of the bone fell upon the upper surface of the soft palate, and was eventually dislodged and rejected by the mouth. It proves to be a portion of the sphenoid bone. The appearance of this bone affords an explanation of the interesting series of phenomena observed in this case. There was disease of the base of the brain, which interfered with the functions of the *fifth*, the *seventh*, and the *eighth* pairs of nerves.

928. I need scarcely observe that the eighth, or auditory nerve, is liable to pressure or disease within the cranium, or within the ear, and that deafness is the consequence. Paralysis of the seventh, and of the eighth not unfrequently exist together, as in the case which I have just related; this *coincidence* leads us to the conclusion that there is some *internal* disease.

929. I must now draw your attention to the *ninth* or *glosso-pharyngeal* nerve. It has long been disputed whether the sense of taste be situated at the *tip* or at the *root* of the tongue. On this question another depends, viz., whether the nerve of taste be a branch of the *fifth*,—long termed the gustatory, or the *ninth* or glosso-pharyngeal, the former being distributed upon the tip, the latter upon the root of that organ. The celebrated Scarpa, in his splendid work on the nerves, has detailed some novel and interesting experiments, from which he concludes that the sense of taste is situated at the tip of the tongue. He observes,—

930. "It is abundantly proved, not merely by anatomy, but by experiments lately made on the human subject by Alex. Volta, Professor of Physics, that the sense of taste resides in the tip of the tongue, and in its margins, almost to the middle of its length; and that, beyond that part, as far as to the base of the tongue, there is either no sense of taste at all, or to a very feeble degree. He applied a plate of zinc to the tip or margins of the tongue, and a silver spoon to the back of that organ beyond the middle part; the handle of the spoon was then brought into contact with the zinc, when an exceedingly acid taste was immediately perceived in the tip or margin of the tongue, which continued so long as the metals were in contact; but there was no sense of taste in the base of the tongue. It must not, however, be supposed that silver is incapable of communicating the electric impulse, and stimulating the tongue; for, upon inverting the application of the metals, so that the silver be applied to the tip or the margins of the tongue, and the zinc to its base beyond the middle part, when they are brought into contact, an acrid, burning, bitter alkaline taste is perceived in the tip or margin, but none at all in the base, where the zinc is applied; hence it is evident that the principal and exquisite sense of taste is situated in the tip and anterior margins of the tongue, from its middle portion forwards, but that the rest of the base and the root possess merely the common sense of touch. By means of this very simple process any one can prove, by his own experience, that the acuteness of the sense of taste is proportionably diminished as the zinc or silver is removed from the tip and margins, towards the back and root of the tongue."

931. Dupuytren deduces the opposite conclusion, from experiments made by himself, with the view of an immediate application to a case of pathology:—

"He dissolved separately, in water, four substances of different flavour, viz., *sugar*, *sulphate of quinine*, *muriate of soda*, and *an acid*. These preparations being made, in order that the experiments might be conclusive, he commenced them upon healthy subjects. Some pupils submitted to them; the tongue being kept motionless, some drops of these substances were placed upon its point; scarcely any flavour was perceived; from which the professor concluded that they acted but little on this part; afterwards, the tongue being still kept motionless, sapid bodies were placed upon the middle and at the base of that organ; the different flavours were then perfectly perceived."

932. *Both* these authors conclude that the *fifth* is the nerve of taste. Dupuytren proves by experiment that the sense of taste resides at the *posterior* part of the tongue, it is well known to him that the *fifth* is distributed to the *anterior* part of that organ, still he concludes that the fifth is the nerve of taste. So difficult is it to free ourselves from preconceived opinions.

933. These questions have been very recently taken up by Professor Panizza. The interesting paper of that physiologist is given entire in the last number of the "Edinburgh Medical and Surgical Journal" (vol xlv., No. for January, 1836, p. 70), and to it I must refer you, briefly stating that the conclusions to which its author is led, are,—1, that the sense of taste resides towards the base of the tongue, in the filaments of the *ninth*, or glosso-pharyngeal; 2, that the sense of touch in the tongue resides near its point, in the filaments of the

fifth; and 3, that the *twelfth* is the true myo-glossal, or motor of the tongue.

934. The experiments of Professor Panizza appear to have been made with great care. An animal in which portions of both glosso-pharyngeals had been removed, would be of constant physiological interest.

935. It will be difficult to confirm or correct these views from experiment by clinical observations. The glosso-pharyngeal is double, and if one part were compressed by a tumour, or destroyed by disease, the other would still partially supply the sense of taste to the tongue.

936. There is an interesting case in point, however, in a note to the translation of Dr. Abercrombie's work, by M. Gendrin (ed. 2, p. 627), which is given in great detail, and which will be read with great interest. The nerve was atrophied by the pressure of a cyst. "The sensibility of the touch of the tongue was preserved along all its extent, the pain produced by the prick of a needle was felt over the whole surface of the atrophied half, as well as on the other half. Cold and heat produced, also, the same sensation upon each half of this organ. Sapid substances, hydrochlorate of soda, acetic acid, extract of colocynth, were successively applied to each half of the tongue; upon the atrophied half they occasioned a very indistinct sense of taste, which was not manifested till seven or eight minutes after their application; whilst, upon the non-atrophied portion, the sensation produced by the application of these bodies was felt acutely after one minute, or a minute and a half."

937. Lastly. The researches of Sir C. Bell, M. Magendie, Professor Müller, and Professor Panizza, have distinctly proved that the *posterior* column of the spinal marrow is formed by the sentient nerves. When this column alone is disorganised, the sense of touch alone is impaired.

938. The subject of affections of the *voluntary nerves* must be deferred to the next lecture. In concluding this, I wish to supply a deficiency in my account of the

Croup-like Convulsion.

939. Amongst other symptoms are frequently observed *bileless faeces*, and *morbid deposits* in the *urine*. That the excitor nerves may transfer their influence in dentition, in gastric crudities, in constipation, to the true spinal marrow, and thence to the branches of the pneumogastric nerve, may be regarded as proved. Now this nerve sends a branch precisely to the *liver* and to the *kidneys*. Through the medium of these branches the secretion, or the *excretion*, of the bile and urine may be impeded, and the events confirm the theory.

940. The *effects* are seen at the extremities of the *reflex* nerves; the *causes* and the *remedies*, act upon the commencements of the *incident* nerves. The true spinal marrow is the *key-stone* between these two arches.

941. In other instances, the pneumogastric is an incident nerve (for it is indubitably a *compound* nerve), and thus it is the *excitor* in vomiting from emetics swallowed, and in cases of hepatic and renal calculus.

N.B. I must observe that there is an error in the sketch given in my last lecture, § 154; the pneumogastric, on the right side, should have been *truncated*; it is represented as joining the phrenic.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, April 7th, 1838.]

LECTURE X.

Diseases of the voluntary nerves. Affections of the fifth and seventh nerves; case by Signor Bellingeri. Augmented action of nerves. The brow ague. Spasm. Diseases of the spinal marrow. Spinal meningitis and myelitis. Symptoms; morbid anatomy; treatment. Effects of congestion and hæmorrhage within the canal. Case of John Bright. Experiments on the frog and toad. Centric convulsions. Paralysis agitans. Mercurial tremor.

GENTLEMEN:—I now proceed to treat of affections,

II.—OF THE VOLUNTARY NERVES.

942. Paralysis of the voluntary nerves is marked by loss of voluntary power over the muscles.

943. When the third, or the oculo-motory, is diseased or compressed, we have various forms of *strabismus*, according as the affection involves more or less of its branches. Some defect of vision is frequently conjoined with it. The strabismus consists in a *defect* or *loss* of movement, which is permanent; and in this it differs from *spasmodic* strabismus, from an affection of another system of nerves.

944. When the *minor* portions of the *fifth*, or *masticatory* nerve, is paralysed, the temporal, the masseter, and the buccinator muscles lose their voluntary powers, and, eventually, shrink and become emaciated. I may refer you to § 924, and to a case published by Sir Charles Bell. It exists in the case in which the *fifth* is entirely destroyed or compressed within the cranium. The patient loses the power of mastication, and of blowing a trumpet, or of smoking a pipe, on the affected side. There is no *distortion*, as in disease of the *seventh*, or facial nerve.

945. In the enumeration of voluntary nerves, *part* of the *seventh* should be included. When this nerve is entirely paralysed, the face is extremely distorted, especially in laughing, &c.; and the orbicularis has lost its powers.

946. Sir Charles Bell's work is replete with the most spirited descriptions of the paralysis of the *fifth* and of the *seventh* pairs of nerves. But I must refer you to his admirable work itself.

947. Sig. Bellingeri and Sir Charles Bell have run the same career of discovery in distinguishing paralysis of the *seventh* or facial nerve. The following case is copied from the former writer:—

"A patient was lying at St. John's Hospital, under the care of Professor Géré, having been affected for a long time with an inflammatory tumour behind the right ear, which had extended both above and below the mastoid process, so as to compress the facial nerve, at its point of exit from the stylo-mastoid foramen; such was the decided opinion of the Professor and of Drs. Gallo and Riberi. Meantime the patient presented almost entire paralysis of the muscles of the right side of the face, and distortion of the left side of the mouth. There was, in fact, complete paralysis of the frontal muscles, the supraciliary, the orbicularis palpebrarum, the levator alæ nasi, and labii superioris, the caninus, zygomaticus, the right side of the orbicularis labiorum, the triangularis and quadratus menti, and colli subcutaneus. The motion of the temporal, masseter, buccinator, and pterygoid muscles, was perfect, or nearly so; of the digastricus we could form no opinion. The motion of the ball of the eye and of the upper eyelid was free; the vision of the right eye was, however, a little injured; the tongue, also, was moved with some difficulty, yet was the taste proved to be unaffected on either side of the tongue; the sense of touch was also uninjured in the face; the hearing was considerably impaired in the right ear; the abscess had opened in the external ear. The patient died in about two months. An effu-

sion of pus was found in the cavity of the tympanum, contained in the aqueduct of Fallopius, and compressing the facial nerve in its course; there was no pus or trace of inflammation about the stylo mastoid foramen after death; but marks of recent inflammation and suppuration in the right lobe of the cerebellum; the fibres and trunk of the fifth pair were uninjured.

948. I have already noticed, § 234-5, the *partial* paralysis of the *seventh* in hemiplegia. The voluntary portion is paralysed; the branch which belongs to the excito-motory system, is unaffected; the eyelid is closed by its sphincter, the orbicularis, during sleep. In *total* paralysis of the *seventh* from the pressure of a tumour, for instance, the orbicularis loses its power, and the eye remains exposed and becomes inflamed. The inference from these facts is, that the *seventh* is *more* than a cerebral nerve. Indeed, the function of the orbicularis, in sleep, so similar to that of the other sphincters, leads to the same conclusion. The question still, however, requires elucidation.

949. I now come to the *twelfth* nerve, or the myo-glossal. Dupuytren gives a most interesting account of a case supposed to be a paralysis of this nerve:—

There were rheumatism of the neck, situated along the vertebræ and occiput; and the gradual loss of muscular power, with atrophy of one half of the tongue, the sense of taste towards the base of the tongue remaining entire. The myo-glossal nerve is supposed to have been involved in the disease at and after its exit from the cranium; hence the affection of the tongue. The scarificator and cupping-glasses were repeatedly applied behind the mastoid processes, with satisfactory results.

After the myo-glossal, I must briefly allude to paralysis of the *anterior* spinal nerves, or *prolongations* of cerebral voluntary nerves within the spine, § 1024.

950. In the "Journal de Physiologie" of Magendie, t. vi., p. 138, there is a case by M. Velpeau, tending to prove the difference of function of the posterior and anterior spinal nerves. M. Velpeau observes, in conclusion:—"The distinction between the different functions of the nervous roots,—a distinction rendered so evident by experiments upon animals,—is still very obscure when we seek to judge by pathological facts; nevertheless, the observation contained in this note is the most conclusive which has been remarked in favour of this opinion."

951. In every case of spinal affection it will be interesting to determine the degree in which the sentient and motor columns and nerves are involved in the disease.

952. Opposed to *paralysis* is *augmented action*. This induces, in reference to the sentient nerves, various kinds of *pain*, the principal of which are those which occur in—

I. *Inflammation Ulceration, Tumours, &c., of the Nerves.*

II. *Neuralgia, or Tic Douloureux.*

III. *Hemicrania Intermittens; Brow Ague, &c.*

953. In reference to *inflammation of the nerves*, M. Descot observes,—"Acute idiopathic inflammation of a nerve, is, I think, very rarely met with.

"The nerves are sometimes affected with a chronic inflammation, and it is generally observed at their extremity in the stump of an amputated limb. When the nerves are in this state, the least contact causes the patient so much pain as to oblige him to submit to a second amputation.

"In many cases of sciatica, I think that the sciatic nerve is the seat of the malady; the pain follows, in general, so exactly the course of the nerve, and the adjacent parts are so free from all pathological appearance, that I think the nerve alone is the seat of the pain; and it appears to me that the affection must originate in an inflammatory action in the neurilemma, which is often terminated by the effusion of a serous fluid."

954. The *subcutaneous tubercle* is attended with most acute pain, proceeding from one point, often extending along the course of the nerves, occurring in paroxysms, which take place spontaneously, or are occasioned by friction or other slight injury of the part, and which frequently disturb the night's repose. The case is distinguished by an examination of the part affected, when a small body, of the magnitude of about half a small pea, is felt under the integuments; this part is generally tender to the touch, especially during the paroxysm, and an acute pain is induced, and is extended along the nerves, by pressure.

955. I published a case of this affection in the "Edinburgh Med. and Surg. Journal," vol. xi., p. 466. It occurred in the thumb of a shoemaker, probably from a puncture of his awl. It was cured at once, after years of suffering, by excision. Similar tubercles, attended by similar suffering, sometimes form at the extremity of the sentient nerves after amputation, or even successive amputations, until the limb, the arm, or leg, has been removed at the shoulder or hipjoint. Such cases have been treated by Mr. B. Cooper, Mr. Mayo, &c.

956. The pain of tic douloureux occurs in paroxysms, which are sudden, irregular in their occurrence, frequently more or less transient or momentary, induced by the act of eating or talking, or by the contact of external bodies with the acutely sentient extremities of the nerves.

957. This disease is distinguished by that which the term *tic* means originally; viz. by a sudden contraction of several muscles, with distortion of the face. Its seat is various, in different parts of the face, of the

limbs, and of other parts of the surface of the body.

958. Many remedies have been proposed for this formidable malady, as division of the nerve, arsenic, carbonate of iron, &c. It frequently arises from deraugement of the primæ viæ, which must be carefully corrected.

959. The *hemicrania intermittens*, or *brow ague*, is apt to recur in spring or autumn, from exposure to the north-east wind; it prevails in damp or marshy districts, and it is frequently observed to accompany the epidemic influenza. It frequently exists as a complication of intermittent.

960. This ague pain occupies the brow, the temple, the forehead, the occiput, &c.; it occurs in paroxysms, frequently of considerable regularity; it is often excruciating, occasionally inducing delirium, and, still more frequently, redness of the conjunctiva. It may recur once or twice in the course of the day.

This pain is almost certainly removed by the quinine or the arsenic.

961. For a full account of these painful diseases, I may refer you, with great satisfaction, to the works of Sig. Bellingeri and Sir Charles Bell; and to the still more recent works of Mr. Swan, in this country, and of M. Descot, in France.

962. I must say word upon

Spasm.

I have hitherto treated of paralysis of the cerebral, sentient, and motor nerves; I must now have drawn your attention to certain spasmodic affections of the latter of these, if I had not my doubts whether the *cerebral* nerves, as distinguished from the *true spinal*, were *ever* affected with spasm. This mere doubt will suggest an inquiry of the deepest interest, both in physiology and pathology.

963. The substance of the brain; the olfactory nerves; the retina, the optic nerve; the auditory nerve; the glosso-pharyngeal, are *insensible* when wounded or pinched. Wounds of the cerebrum do not induce spasmodic contraction. No experiment has hitherto been made upon any purely *cerebral* voluntary nerve, with the view of determining whether, in such a case, there would be spasmodic action. Perhaps such a nerve does not exist free from the intermixture of *true spinal* filaments. Is the *third*, or the *oculo-motory*, of this character? These, with many other questions, are still left for future inquiry.

THE DISEASES OF THE SPINAL MARROW.

964. It is utterly impossible to understand the diseases of the spinal marrow, without a constant reference to its peculiar functions, as distinguished from those of the encephalon. I refer you to the observations which I made in previous lectures upon this distinction.

965. Such diseases of the spinal marrow as may materially affect its functions, induce, in the first place, paralysis of cerebral nerves, sentient and voluntary, which run along its course, forming a part of its structure; and, in the second, either an excited or paralysed condition of its own peculiar functions. The symptoms combine, therefore, paralysis of sensation and voluntary motion, in the parts below the disease, with spasm and ultimately paralysis, resulting from the affection of the *true* spinal marrow. I have spoken of the anatomy, and of the physiology; from these you may deduce the symptoms.

966. In treating of the diseases of the spinal marrow, I shall pursue the following order. I shall notice,—

I. *The Central Diseases, or Diseases of the True Spinal Marrow itself.*

II. *The Centripetal Diseases, or Diseases excited through the Excitor Nerves.*

III. *The Centrifugal Diseases, or Diseases of the Motor Nerves.*

In designating them, I have borrowed terms used by Professor Müller, in reference to physiological actions.

967. Of these diseases the first is

Inflammation within the Spine,

and this, like encephalitis, § 779, is to be distinguished into—

1. *Inflammation of the Membranes, or Spinal Meningitis.*
2. *Inflammation of the Substance, or Spinal Myelitis.*
   a. *Of the Cerebral, or Sentient and Motor Tracts.*
   b. *Of the True Medulla*; and
   c. *Of its Principal Divisions.*

968. *The causes* of inflammation within the spine are, principally, blows or falls, violent muscular efforts, and exposure to damp or cold. One patient became affected with acute spinal myelitis from being long exposed to the rain and cold in an open boat. This affection has frequently occurred from the pernicious custom of lying upon the damp grass. Rheumatism seems occasionally to have led to this disease. The observations of M. Louis have distinctly shown the connection between caries of the vertebræ and spinal myelitis.

969. *The symptoms.*—It is rare that meningitis of the spine exists without meningitis within the cranium. It is equally rare for the membranes to be inflamed, or one of the cerebral tracts, without affection of the substance, or of the other portions of the spinal marrow. The distinctions between these affections are not, therefore, easily defined. (See § 950.) Happily they are not essential to the treatment. Those symptoms which point to such distinctions will be noticed, however, as we proceed.

970. A much more interesting distinction arises from the various locality of the in-

flammation, according as it affects the medulla oblongata, or the cerebral, dorsal, lumbar, and sacral portions of the spinal marrow. A knowledge of the anatomy and physiology frequently enables us to define the region of the spinal marrow which is the seat of the disease, and guides us at once in our prognosis, and in the local application of remedies, the most important part of the treatment.

971. In general the symptoms of meningitis are *more* those of *irritation* of the spinal marrow, or *spasm*; those of *myelitis*, *more* those of *destruction* of the organ, or paralysis. Both kinds of symptoms may exist, however, or follow each other, in both diseases.

Diseases, especially those of the nervous system, are usually more complicated in individual patients, than as they are described in books. Hence a difficulty in the commencement of practice. You are led to expect impossibilities—diseases well defined in their simple forms. It will be well for you, in reference to our present subject, especially, to become well acquainted with the anatomy and the physiology, and you will then be able to interpret each symptom justly, as it appears.

972. Amongst the first symptoms of spinal *meningitis* is local *pain* in some part of the spinal column, augmented by the movements of the patient, and by percussion, but rarely, if ever, by pressure along the spine. This pain sometimes extends along the back and limbs, in which there is then tenderness on pressure,—a symptom which may serve to distinguish meningitis from myelitis, in which there is usually loss of sensibility.

973. The next important symptom is spasm, or various kinds of muscular contraction. The head, the neck, or the trunk is bent backwards, or there is trismus, torticollis, partial or complete opisthotonos, or contractions of the limbs,—constant, or recurrent, or exacerbated, in paroxysms, on moving, or being moved, &c., with extreme pain; sometimes there are convulsions.

974. The respiration is sometimes difficult. There is sometimes retention of urine and constipation.

The symptoms will vary according as the meningitis exists at the base of the brain, at the upper or at the lower part of the spine principally.

975. The symptoms of spinal *myelitis* are those of paralysis of sensation and voluntary motion; a sense of numbness, an impaired sensibility, a sense of feebleness, an impaired muscular power, are first observed, singly or combined, in one or both of the inferior or superior extremities.

976. In some cases, probably of complication with meningitis, there is augmented sensibility. In other cases there are spasmodic or convulsive affections.

If the disease proceeds, the paralysis of sensation and voluntary motion gradually augments. Generally the paralysis affects first the inferior, and afterwards the superior extremities; far more rarely it pursues a contrary course: occasionally the motions alone, and, very rarely, the sensations alone, are paralysed.

977. If the disease occupy the *upper* parts of the spinal marrow, the respiration, and even the action of the larynx and pharynx become impaired, and we have difficulty or choking in swallowing, or asphyxia. There is sometimes the sensation of a cord-like tightness across the epigastrium. If the *lower* part of the spine be affected, the bladder, the rectum, and their sphincters, are variously paralysed, and there may be retention of urine and constipation, or involuntary evacuations, or retention and involuntary flow of urine may be combined. The condition of the bladder, and the condition of the rectum should be ascertained by proper examinations, *in every case*.

978. In some instances there is perfect impotence, or inertia of the uterus; in others the patient has become a father, or the uterus has been excited to expel the fœtus. On these points I must refer you to the observations of MM. Chaussier, Serres, Brachet, &c.

These differences, doubtless, admit of explanation by a reference to the *kind* of affection,—irritation, or destruction, and its *locality*,—in the cervical, dorsal, or lumbar portions of the spinal marrow.

979. You will find a valuable case of uncomplicated spinal *meningitis*, considered by M. Cruveilbier, as affording a type of that disease, by M. Dance, in M. Ollivier's work, p. 551. In M. Louis, admirable "Memoirs," there is an interesting paper on the condition of the spinal marrow in caries of the vertebræ, in which you will learn the symptoms and morbid changes in *myelitis*,—p. 410; and especially pp. 445-447. This work is in the library.

980. *The morbid anatomy* is in every respect similar to that of cerebral meningitis and myelitis. It is rare, indeed, that spinal meningitis occurs without a similar affection of the membranes of the brain. Injection of the pia mater, and of the spinal vessels in general, effusion of serum, lymph, pus, and blood, under the arachnoid, diffused, or in portions; perhaps softening of the adjacent medulla. The arachnoid itself is free from blood-vessels; the morbid changes supposed to take place in this membrane have their seat in the subjacent cellular membrane, or in the pia mater.

981. In *chronic* meningitis there are sometimes membranous adhesions and effusion of a cartilaginous hardness.

The principal morbid change in myelitis is softening, which may occupy the whole, or any portion, either side, or the anterior or posterior part of the spinal marrow; it most

frequently affects the cervical or lumbar portions. There is, as in the same affection of the brain, a degree of tumefaction. Induration is the frequent result of *chronic* myelitis.

982. The most efficacious *treatment* of inflammation within the spine, consists, I believe, in the application of cupping, in acute cases, and of issues and setons in the chronic.

Cupping may be applied so as to involve the two principles of local depletion and counter-irritation; for this purpose the scarification should be applied deeply and crossed, and little blood should be drawn, the operation being repeated according to the violence of the disease, and the powers of the patient.

983. In reference to the use of issues, M. Louis makes a very apposite remark:—"Experience has demonstrated the utility of cautery in Pott's disease, when that affection is of long standing, and voluntary movement more or less seriously injured. A necessary consequence of the foregoing is, that the same means ought to be employed in the simple, or primitive softening of the spinal marrow."

984. The administration of mercury in the acute cases, and in the chronic cases, when these are uncomplicated with a tubercolous diathesis, is an important measure.

The most moderate diet should be enjoined, the bowels should be kept free; the recumbent posture, with the utmost quiet, should be preserved. For further suggestions for the treatment, I may refer you to what I have said upon the treatment of encephalitis. (§ 797.)

II.—Congestion—Hæmorrhage.

985. I believe that little can be said of these forms of spinal disease. If they can ever be suspected during life, it can only be from the suddenness of the accession or attack of the symptoms; and the treatment must be the same as in acute inflammation within the spine.

986. In connection with diseases of the spinal marrow, I wish now to draw your attention particularly to the state of the limbs in cases of *paralysis*, especially *paraplegia*.

987. I was informed by Sir B. Brodie, Bart., that Professor Macartney, of Dublin, first drew his attention to the occurrence of motions in the paralysed limbs in paraplegia, on the application of a stimulus, and to that of priapism on the introduction of the catheter.

It may not be uninteresting to subjoin the following note, which I have just received:—

"My dear Sir:—In reply to your letter I have to say that Sir Benjamin Brodie very accurately stated the fact as I had communicated it to him, respecting the priapism which is so apt to be produced by injuries of the spinal marrow. In the case to which he alluded the man injured the spine by falling into a quarry. The erection of the penis was very violent immediately after the accident, and occurred at intervals for several weeks afterwards, especially on the slightest friction of the glans penis, so as to create much inconvenience in the introduction of the catheter. He had no consciousness of what was going on unless he put down his hand to the part, or looked at it.

"I have seen similar cases of erections after injury to the spinal marrow, but not in so extreme a degree, and I have observed a violent priapism in two men who were suffering death by hanging. I am very truly, yours,

"J. Macartney.

"35, Upper Merrion-st., Dublin,
March 29, 1838.

"To Dr. Marshall Hall."

I may further add that in the case of Greenacre, Mr. Girdwood observed that the tongue was violently protruded, as the effect of his attempt at suicide by strangulation. This is another point in which strangulation resembles the epileptic seizure.

Sir B. Brodie has confirmed this remark by his own observation. He observes,—"Priapism occurs even where the sensibility is entirely destroyed, and may be induced by the mechanical irritation caused by the introduction of the catheter, where the patient is entirely unconscious of the operation. This circumstance was pointed out to me many years ago, by Professor Macartney, of Trinity College, Dublin; and I have had many opportunities of verifying the correctness of the observation."—Med. Chir. Trans., xx. 141.

988. I have seen a variety of examples of the continuance of the excito-motory or reflex actions in cases of perfect paraplegia, both of sensation and voluntary motion, in the human subject. These cases have delivered us from the incessantly recurring doubt about *sensation* as the source of these actions, and are, besides, interesting in themselves. For one case I am indebted to my most intelligent pupil, Mr. Barlow, of Writtle, Essex; for another to Dr. Budd; for a third, to Dr. Elliot, of Carlisle. One case I saw, on the invitation of Mr. Liston, at the University College Hospital. There is an interesting case which presents these phenomena, at this moment under the care of Dr. Bodd, in the Seamen's Hospital, the *Dreadnought*.

989. I shall give you the case of Mr. Barlow, in his own words. It is doubly interesting from the sketch of the effects of the injury on the upper dorsal vertebræ, with which I am enabled to present you.

990. It is plain that the spinal marrow must have been destroyed at once.

991. "John Bright, ætat. 19, on the 1st of October, climbed up a walnut-tree, for the purpose of picking the fruit, and when he had attained a very considerable height slipped, and was precipitated to the ground. He was soon afterwards found, in a cold and pulseless condition, with his lower extremities numb and motionless. These symptoms at first naturally led to the supposition, that there was a fracture of the spine, but examination gave no proof of it, and afforded no evidence of displacement. There was, however, a slight swelling in the situation of the two or three first dorsal vertebræ, and pressure there was attended by pain. He was much depressed by the violence of the shock, and his articulation was faint and indistinct. A few hours after he had rallied, and complained of pain in his head, and giddiness, which were relieved by moderate depletion. There was obstinate costiveness of the bowels, which was overcome by strong purgatives, and retention of urine, which required the introduction of the catheter; and it was necessary to repeat this operation, at proper times, for a month after the accident, subsequently to which the bladder became incapable of retaining its contents. Although every attention has been paid him, sloughs have formed on the integuments of the back.

992. "The following is the present state of the patient, three months after the accident:—The lower half of his body and inferior extremities are entirely devoid of sensation, and they are not, in the slightest degree, under the influence of the will; sometimes the patient has cold shiverings; and whilst the muscles of that part of the body supplied with nervous energy from above the seat of injury are observed to shake,—those deriving their nerves from below that spot are perfectly motionless. This has been often remarked by his mother, who waits upon him.

993. "Notwithstanding the anasthesia, and the patient's inability to effect a single movement through the medium of volition, when the integuments of the legs are pinched, or more particularly when the sole of the foot is tickled, the extremities are retracted with considerable force. A little cold water dashed upon the surface produces the same effect, though there is no feeling of coldness. One leg is constantly in the flexed position, and if straightened, immediately recovers it again. When the catheter is introduced, the penis is excited into a state of complete erection, and this is invariably consequent upon the gliding of the instrument along the urethra; at the same time the legs are drawn up, and a twitching of their muscles is very obvious.

994. "That the muscular contractions, so easily excited by various stimuli, are referable to the 'reflex function' of the medulla spinalis, cannot but be admitted. In this case all communication between the brain, and that part of the chord from which the lower half of the frame derives its nervous power, is, so far as function is concerned, effectually cut off; therefore, to the agency of the spinal marrow, are owing those movements of which the mind knows nothing, and which, at first sight, seem to denote the perception of an irritating cause, and the wish to avoid it, though, upon inquiry, it is found that no sensation exists whatever. The sequel of the case will be interesting; and as the patient is under the care of my father, I shall have an opportunity of being acquainted with the result."

995. Dr. Budd's case was one of spinal curvature, involving from the 5th to the 11th dorsal vertebræ. It occurred in an innkeeper, beginning at the age of 18; the following phenomena were observed at that of 48:—

"The paraplegia was nearly complete, with dysury and constipation. By much exertion of the will, he communicates a slight degree of motion to his thighs, which, however, must be narrowly watched to be seen; he cannot move his legs, or feet, or toes, in the slightest degree, and an effort to do so makes him feel sick; when, however, any part of the skin of his lower extremities is smartly pinched, the corresponding limb jumps with great vivacity; the foot is suddenly raised on the heel; the toes are forcibly retracted to the instep; and the knee starts so as slightly to extend the leg; the parts are maintained in this state of tension for several seconds, and are then suddenly relaxed. This phenomenon may be repeated at will, and does not seem to diminish by a succession of trials. The retraction of the left lower extremity is more marked and

vigorous than that of the right. The sensibility of his lower half begins to fail at the umbilicus, and is very faint below that; he does not feel in his legs unless when smartly pinched, and then not disagreeably. He has no control whatever over the retraction above described, and when I pressed my hands on the backs of his toes, at the same time pinching the leg, my hand was removed by the force of the retraction."

996. A few months afterwards the following observations were made:—

"His lower extremities have recovered some share of sensibility; this is not sufficient to inform him of simple contact, of which he is perfectly unconscious, even when accompanied by a considerable degree of pressure; but when I firmly pressed the edge of my nail over any part of the skin of the legs or thighs he felt it, and was aware of the nature of the act; the impression was incomparably stronger when I did the same to his arms, or any part of the upper half of his trunk. He was conscious of pinching, but it was necessary to pinch him very smartly to occasion any painful sensation. The sensibility of the right leg is rather duller than that of the left, as far as I could well ascertain. His great toes are the only portion of his lower extremities endowed with the least share of voluntary motion. When asked to do so, he moves them to and fro twice or three times (never more than three times), through a very small extent of their natural motions, and then, exert himself as he will, *all voluntary influence ceases.* I had no watch to measure, but I should think it to be a quarter of an hour before he recovers a similar power.

997. "By no exertion of his will can he move any other part of his lower extremities, in the slightest degree. When I pinched his leg smartly, the involuntary contraction immediately occurred as formerly, and as witnessed by you; the toes were bent towards the instep, the instep towards the front of the tibia, bringing the foot to rest on the heel; the leg considerably bent on the thigh; the whole so forcible as to remove any obstacle the strength of my arm could oppose to it. The contraction was, as formerly, much less vigorous when excited in the right leg than when in the left. I now scratched lightly with my nail, as if to tickle, the sole of his left foot; the contractions which ensued exceeded in vigour at least fourfold, any that I had yet wituessed. While I continued to scratch the contractions succeeded one another in a series of jerks of the most remarkable vivacity. I asked him if he felt the tickling, he said, '*not in the least*, but you see, Sir, *my foot did well enough.*'

998. "I observed that the contractions were more vigorous when I scratched the hollow part of the foot, which verges towards the malleolus internus. In endeavouring to experiment on other parts of the limb, adopting that form of excitement which tickles most in health, I did not succeed in obtainiug any but feeble contractions, much more feeble than those procured by pinching. In all these experimeuts the contractions of the right leg were much less vigorous and less extensive than those of the left; the contractions were, also, entirely confined to the excited limb, its fellow remaining perfectly motionless. I said perfectly motionless, but when I tickled the sole of his left foot once or twice, the great toe of the right foot moved to and fro; this motion was not more extensive than the voluntary motion I have described above, scarcely disturbing the toe: it did not occur uniformly, but it never occurred in the left foot when the right foot was tickled. I tickled other parts of his body, his arms, and his ribs, so as to make him laugh lustily, but it did not produce the slightest effect on his legs. I now come to the sphincters; they not only act, but in their action they exhibit one of the most interesting manifestations of the reflex function. When he makes water the urine is expelled in rapid and successive jerks, the stream being cut off at very short intervals. After a portion of time, which is very variable, these interruptions totally cease, and the urine flows in a full stream, until the bladder is emptied. Defæcation also suffers interruptions of the same nature, the mass of fæces being *cut into parcels* by the sudden and repeated contraction of the sphincter ani. This contraction at times becoming permaneut and uninterrupted, is what has always constituted the obstacle to defæcation, and uot coustipation, in the common acceptance of the term. But while these pheuomena are takiug place in the sphincters themselves, the lower extremities are not at rest; indeed, the contractions which then occur in them are incomparably more vigorous than on any other occasion; their contraction is so powerful, that when sitting on the night-stool, he would be violeutly thrown forward on the floor, did he not take means to prevent it. To this end he has had two large loops of saddler's webbing nailed into the floor; into these he thrusts his feet; and an attendant proceeds to keep down his thighs before he commences operations; even thus provided the function sometimes suffers considerable disturbance from the uncontrollable movements of his legs. The contraction in the lower extremities (both at once) begin and leave with the corresponding affection of the sphincters. He feels his urine pass; it occasions a warm tickling, and at times a sense of burning along the course of the urethra; he is scarcely conscious of defæcation.

"Coition has not taken place since the date of his affection, but erections are not

unfrequent, and occur, he says, whenever he handles his penis; the sensation they are accompanied with is very faint, and they do not excite desire."

999. Dr. Elliot's case is, also, one of spinal curvature, with a fluctuating swelling, in the region from the fourth to the seventh dorsal vertebræ, with "*paraplegia* and *rigid flexure* of the lower limbs."

The loss of sensation and of voluntary motion was complete, but "powerful involuntary movements were produced in various ways."

1000. I am indebted to Dr. Elliot for the following interesting account:—

"There appeared to be no sensation from a little above the crest of both ilia downwards, on pinching, rubbing, and scratching with a pin. Friction with the hand over those parts of the abdomen devoid of sensation, and over the ilium, on the right side, produced, when the girl lay on the left side, powerful extension of the right leg and thigh, *i. e.*, the limb, if previously bent, became straight, and was forcibly moved backwards. Friction over the sacrum caused instant flexion of the knee and thigh; friction of the corresponding surfaces on the left side produced very irregular motions of the left lower limb."

1001. I believe some doubt was expressed relative to the complete absence of sensation in this case; but the facts of excito-motory phenomena in paraplegia in the human subject, independent of sensation, are now too numerous to admit of the cavilling which long prevailed upon this point.

1002. I have now an interesting case to add, for which I am indebted to Mr. Roberts, of Everett-street, Russell-square:—

A young lady, aged 27, had a fatty tumour, within the tenth and eleventh dorsal vertebræ; it gradually, but completely, severed the spinal marrow, and induced perfect paraplegia. The bladder lost its power of retention. The singular fact in this case was this:—on giving a dose of tincture of cantharides, the power of retaining the urine was always restored *for the time*. This power would cease, and again be restored, on suspending or repeating this medicine. It is obvious that the cantharides acted through the segment of the excito-motory system left below the division of the spinal marrow.

1003. In some cases of perfect paraplegia, both of sensation and voluntary motion, these phenomena have not been observed. What is the rationale of this fact?

1004. Very early in this investigation I observed, that the spinal marrow of a frog was divided between the anterior and posterior extremities. It was immediately observed, that the head and the anterior extremities alone were moved spontaneously and with design, the respiration being performed as before. But the posterior extremities were not paralysed; they were drawn upwards, and remained perfectly motionless, indeed, unless stimulated by the application of any stimulus they were moved with energy, but once only, and in a manner perfectly peculiar. The stimulus was not felt by the animal, because the head and anterior extremities remained motionless at the time it was applied. Nothing could be more obvious, and indeed striking, than the difference between the phenomena of the functions of sensation and volition observed in the anterior part of the animal, and those of the reflex function in the posterior; in the former there were spontaneous movements with obvious design; in the latter, movements which were the mere effect of stimulus.

1005. The same experiment was made upon the toad, but for some reason, probably anatomical, it does not succeed so uniformly in this animal as in the frog.

1006. This phenomenon is, in fact, explained by a reference to the comparative anatomy of the frog and toad. M. Desmoulins observes ("Les Systèmes Nerveux," tom. i., p. 787), "in the frog the insertion of the lumbar nerves takes place *lower* than in the toad, by one-fifth of the length of the spinal canal." In the experiment on the frog the *spinal marrow* was divided; in the toad it was the *cauda equina*; the *key-stone* of the incident and reflex arcs, was excluded, the effect of which is explained § 60. Is it not interesting to see physiological facts, unintelligible, at first, explained by reference to the anatomy?

1007. The very same explanation applies to the cases of paraplegia, unattended by phenomena of the reflex, excito-motory action. The disease is seated *below* the termination of the spinal chord; it is, therefore, a disease of the *nerves*, and represented § 61. The influence of both nervous centres, of the cerebrum, and of the true spinal marrow, is removed.

It is an interesting and difficult question, Why all the phenomena of this reflex, excito-motory action do not equally occur in health. Is it that in paralysis the irritability of the muscular fibre is augmented?

1008. In the case at the Seaman's Hospital, the *Dreadnought*, I am told that sensation remains. It is plain, then, that the presence of this faculty is not incompatible with the excito-motory action; only such a case does not afford the proof, *which the others do*, that the excito-motory actions are independent of *sensation*.

1009. Dr. Whiting has proposed an interesting subject for inquiry,—Why are the excito-motory phenomena absent in hemiplegia? The first question is, Is it so?

1010. In a patient in deep coma, I pierced the skin on the cheek, the hand, the thigh, &c., with a pin; there was no manifestation of sensation, no motion whatever.

I then touched the eyelash and the *internal* nostril with a feather; this induced action of the orbicularis and levator alæ nasi; I then pricked the *exterior* part of the nostril with the pin; the action of the levator was immediate. The respiration was almost entirely diaphragmatic. There was effusion in the ventricles; no other morbid appearances.

1011. To this phenomenon I have ventured to apply the designation of the *cynic spasm*, for it is probably the σπασμος κυνικος of Hippocrates; and it is certainly allied to the sardonic laugh. It is excited through filaments of the trifacial nerve (the "*nervi ethmoidales, ramus narium externus*," the "*nervi laterales narium superiores et inferiores*); these, when excited under particular circumstances, induce contractions of the levatores alæ nasi. I may refer you, also, to § 764.

1012. A similar question applies to the comparative absence of the excito-motory phenomena, on passing the catheter, the fæces, for example, in health.

III.—Centric Convulsions, or Epilepsy.

1013. Any disease within the cranium or spine, whether effusion, tumour, exostosis, &c., may induce convulsions or epilepsy.

Fright, or other sudden mental emotion, has induced convulsion, and this convulsion has been repeated, affording one of the most deplorable cases of epilepsy.

1014. I have already suggested, indeed, that *all* convulsive diseases are affections of the true spinal marrow. I refer you to the observations made in a preceding lecture.

The cerebrum is obviously the seat of the mind; it is neither sentient itself, nor the originator of motions in itself.

1015. The true spinal marrow, on the contrary, is the term of certain excitements and the source of certain motions; the centre, in a word, of a peculiar series of excito-motory phenomena, physiological and pathological. Unlike the cerebrum, it induces, if stimulated, convulsive movements in the organs, appropriated to ingestion and egestion, and in the limbs.

1016. Diseases within the cranium, by irritating excitor nerves, or the medulla oblongata, induce convulsions or epilepsy, too frequently, alas, of an incurable character.

Disease within the spinal canal may prove the source of convulsion or epilepsy, still more immediately. This form of epilepsy is also, for the most part, incurable.

These cases are, for obvious reasons, frequently met with in hospitals, asylums, and workhouses.

Hence the idea that epilepsy is not to be subdued by medicine, prevalent amongst those who draw their conclusions from observations made in these establishments.

IV.—Paralysis Agitans.

1017. I must now draw your attention, very briefly, to another disease of the spinal marrow, the paralysis agitans. Its symptoms have been well described by Mr. Parkinson, but its morbid anatomy has not been traced. It is usually a disease of advanced life.

Paralysis agitans is either—

1. *General*, or
2. *Hemiplegic.*

1018. The first symptoms of this *insidious* disease is weakness and tremor of the head, for instance, of the hand, &c. In about a year the other hand, or a lower extremity, is affected, or the patient loses his balance in walking. Generally no *cause* can be assigned.

1019. There is perpetual tremor, even when the part is supported; the head, the hand, the leg, are moved incessantly; reading and writing became impossible, and the patient cannot guide his hand to his mouth, at length he loses his balance and there is a constant tendency to fall forwards, and, in order to avoid this, to run or move with a quicker pace, and on the toes.

1020. At a later period the tremor continues during sleep even, augmenting until the patient awakes. There is increased weakness, the trunk is bent forwards, the upright position can no longer be supported; the articulation becomes indistinct, mastication and swallowing imperfect; the bowels are all along torpid, then obstinate; at last the urine and fæces are passed involuntarily. In the last stage of all there is slight delirium or lethargy.

1021. The symptoms have, in several particulars, a marked resemblance to the effects observed by M. Serres of diseases of the *tuber annulare*, and of the *tubercula quadrigemina.*

1022. Of the hemiplegic paralysis agitans, I have long had an interesting case under my care:—

—— Macleod, aged 28, is affected by weakness and agitation of the right arm and leg, augmented on any occasion of agitation, and on moving; it is observed as he walks, or when he passes his cane from one hand to the other; there is, besides, a peculiar lateral rocking motion of the eyes, and a degree of stammering and defective articulation.

Nearly allied to paralysis agitans is the

V.—Tremor Mercurialis.

1023. This disease affects workers in mercury, chiefly those occupied in silvering mirrors.

The symptoms are, at first, paralytic tremor and debility, and perhaps ptyalism; afterwards convulsive agitation of the limbs wheuever they are moved; the articulation becomes imperfect; the hands are so agitated that a partly-filled cup cannot be con-

veyed to the mouth* without spilling the liquid. On attempting to walk the limbs dance and perform irregular movements; whilst sitting still the patient may remain free from chorea, but on every exertion of the volition, and on every occasion of mental agitation, the irregular movements are renewed. The sleep is disturbed, the patient awakes alarmed by terrific dreams; there are nervousness and debility; the bowels are constipated.

* In a letter written from Venice by the learned Dr. Walter Pope, on the miners of mercury in Friuli, and published in the "Philosophical Transactions," vol. i., for 1665, a case is detailed of a patient who "could not with both hands carry a glass half full of wine without spilling it, though he loved it too well to throw it away."

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From THE LANCET, April 14th, 1838.]

LECTURE XI.

Case exemplifying the effects of injury of the anterior column of the spinal marrow. CENTRIPETAL EPILEPSY.—*Its causes, symptoms, and treatment.* PUERPERAL CONVULSIONS. —*Remarks by Dr. Denman. Tetanus; centric and eccentric forms of the disease; principles of treatment. Hydrophobia. Hysteria; its differences from epilepsy. Chorea; physiology and treatment of the disease. Stammering. Anonymous critics.*

1023. GENTLEMEN:—I must proceed, in this lecture, to treat of those diseases of the true spinal system, which have their *origin*, not in the spinal centre itself, but at the origins (extremities they are erroneously termed) of the incident excitor nerves, through which they act, and successively affect the spinal centre and the reflex motor nerves.

1024. Before I do this, however, I have an interesting subject to bring before you, which relates to the spinal centre itself. According to the views of Sir Charles Bell, an affection of the *posterior* column of the spinal marrow would interfere with the function of *sensation*, whilst that of the *anterior* column would exert its influence upon the *movements*. I must recal to your minds the observations made in a preceding lecture (§ 9—12) upon this subject. I now present you with one of the most interesting cases illustrative of the effect of *irritation* upon the *anterior* column of the spinal marrow in the human subject, it is possible to imagine. I am indebted for it to Mr. Brayne, of Banbury. First let me draw your attention to the subjoined sketch.

Observe the exostosis at the posterior part of the body of one of the vertebræ. This

angular body constantly irritated the adjacent or anterior column of the spinal marrow; the effect I will detail to you in Mr. Brayne's own words:—

1025. "The patient, a brazier by trade, and about forty-five years of age, had spinal angular curvature, extending through several of the dorsal vertebræ. The peculiar feature of the irritation of the chord, in addition to the usual symptoms of more or less paralysis of the sentient nerves, was great and incessant spasms and contractions of the muscles, chiefly of the flexors of the lower extremities, and also of those contracting the passage of the alvine and urinary secretions. Sometimes the urine would be forcibly ejected, and at another time the introduction of the catheter was exceedingly difficult. The irritation of the motor tract was so severe in its effects on the muscles of the thighs, that the heels were pressed so strongly against the buttocks as, at one time, to create ulceration. After death, a *rough* nodule of bone, like an exostosis, was found to project from the body of one of the vertebræ, about the middle of the curvature to the extent of half an inch into the canal of the spine, and, no doubt, was the

cause of the severe marks of inflammation and disorganisation which the chord and its coverings at that point presented, and occasioned the symptoms in question."

1026. I now proceed to treat of those diseases of the true spinal system which originate at a distance from the spinal centres; and

I.—Of Centripetal Epilepsy.

1027. This form of epilepsy takes its origin in the *excitor nerves* of the true spinal system, involving the axis of this system, and its motor nerves, in their turn; functionally, however, not organically. It is for this reason that I have denominated this form of epilepsy, *centripetal*.

1028. This form of epilepsy is to be viewed as *curable*, however *difficult* of cure. By avoiding the exciting causes, its attacks are avoided, the susceptibility to returns subsides; these returns become less frequent, and less severe, and, at length, frequently cease altogether. Everything depends upon rigid rules proposed by the physician, and strictly and perseveringly observed by the patient.

1029. In describing the *causes*, *symptoms*, and *treatment*, of eccentric epilepsy, I must recal to your minds all that I have said respecting the anatomy and physiology of the true spinal system. *Every* part of this system is distinctly but exclusively involved in the circumstances of this disease: if the encephalon suffer, it is only as an *effect* of the convulsive attacks.

1030. The principal causes of eccentric epilepsy, are, 1, the presence of indigestible food in the *stomach;* 2, the presence of morbid matters in the *intestines;* 3, *uterine* irritation. The first of these acts through the medium of the pneumogastric; the second and third through that of peculiar spinal nerves,—all *excitors* belonging to the true spinal system. Compare what I have already stated on this subject.

1031. I have so repeatedly known a patient, subject to this form of epilepsy, experience an attack within five minutes of eating some indigestible article of food, or on experiencing a deranged condition of the bowels, or on every return of the catamenial period, as to leave no doubt upon my mind upon these important points. I have known the attacks prevented by a steady and cautious attention to rules in reference to these circumstances.

1032. In detailing the *symptoms* of epilepsy, I shall have to repeat all that I have said respecting the physiology of the true spinal system; every part, every function, which belongs to that system, is involved in the pathology of epilepsy; the functions of ingestion and of egestion are precisely those affected in this disease; the *causes* act through the *excitor* nerves, the *symptoms* are manifested through the *motor* nerves (p. 15, 16) of that system.

1033. The first thing observed is a varied *distortion of the eyeball*, which is drawn from the axis of vision generally upwards, and outwards, or inwards, and of the features. The second symptom is a forcible closure of the *larynx* and *expiratory efforts*, which suffuse the countenance and, probably, congest the brain with venous blood. In all these circumstances there is a most marked and important difference between epilepsy and hysteria, on which I shall insist hereafter.

1034. In the third place, we observe that the tongue is thrust out of the mouth by the genio-glossal muscle, whilst the teeth close upon it by the action of the masseters, and it, or the upper lip, is frequently severely bitten; or, without the spasmodic protrusion, and consequent injury of the tongue, there is grinding of the teeth.

1035. We next observe convulsion,—which is general, or of the whole muscular system, or hemiplegic, or confined to one side; or it occurs in the form of trismus, torticollis, in one limb, &c.

1036. During these attacks, the *expulsors* of the fæces, the urine, or the semen, sometimes act, and there is the unconscious evacuations of these secretions. There is sometimes rigidity of the penis. On this subject I must refer you particularly to what I have said in another lecture.

1037. You will see, from this brief account of the symptoms, how peculiarly an affection of the true spinal or excito-motory system, epilepsy, is. The previous arrangement of the functions of the system, in your mind, will enable you to remember and to explore the symptoms of this disease most accurately.

1038. I must now draw your attention to another set of *facts*, as *causes*, and also to another set of *symptoms*, as effects, of the paroxysm.

1039. Deep sleep, broken sleep, loss of rest, passion, vexation, exhaustion, inanition, and, especially, rising with an empty stomach, have frequently led to a paroxysm of epilepsy, and must, consequently, be carefully avoided in our rules of regimen for the cure of this disease. I have already alluded to the relation of the συνοσια and epilepsy.

1040. I have known the act of washing the hands in cold water, induce an attack of epilepsy; I have known dashing cold water on the face prevent such an attack. These phenomena must be observed with accuracy.

1041. The *effects* of the epileptic paroxysm, to which I have just alluded, are the venous congestion of the brain, and the consequent effusion of serum in repeated attacks—effects carefully to be avoided by the appropriate remedies, on account of the havoc produced by them on the mental faculties and cerebral functions.

1042. Our task consists in preventing the

attacks of epilepsy, and, if this cannot be accomplished, in treating these attacks, and in obviating their effects on the *cerebral* system. We accomplish this task by cautiously avoiding the *causes*, by moderating the *paroxysms*, and by local means of subduing vascular action, and, perhaps, of depleting the vessels of the brain.

1043. The strictest rules must be laid down for the diet, for the state of the bowels, for conducting the catamenial periods. These last should be passed in bed; the feet and abdomen should be fomented; the warm-water enema, and the opiate enema, should be administered.

1044. The immediate accession of the paroxysm may sometimes be prevented by dashing cold water on the face, or by exciting the nostrils by snuff, &c. In this manner the disposition to closure of the larynx, and expiratory efforts, is exchanged for sudden acts of inspiration.

1045. In the paroxysm, the patient must be prevented from injuring himself by falls or blows. In this danger of injury we have another marked distinction between epilepsy and hysteria.

1046. The stupor, or coma, induced by the paroxysm may require the administration of bloodletting, general or topical, according to its degree and deviation, and probable effects. But tracheotomy is the remedy against the stupor, or coma, following the attack of epilepsy, if it exist in a dangerous degree, (see § 571).

1047. Besides the means to which I have alluded, other remedies have been proposed for the cure of epilepsy, in an empirical manner, without due attention to the *kind* of the disease. It is obvious that little attention can be paid to propositions and observations so vague and indefinite. These various remedies must be tried anew, after a strict diagnosis. We shall then arrive at an approximation to the truth in reference to the value of these remedies respectively.

1048. The views which I have given of eccentric epilepsy are amply confirmed by the facts, that there is no constant morbid change observable in this disease, and that many patients, after long years of its attacks, have finally and fully recovered,—facts which ought to encourage us steadily to pursue the mode of treatment.

1049. A system of exercise, regulated sleep, the shower bath, tonic remedies, &c. &c., must be added to the other plans.

1050. After this plain and practical view of the subject, I wish to draw your attention to a few other points of intense interest in reference to epilepsy.

1051. Sometimes the attack *consists* in a momentary loss of consciousness, "oblivium quoddam et delirium adeo breve, ut fere ad se redeat, priusquam ab adstantibus animadvertatur." — *Heberdeni Comment.*, cap. 33. Sometimes this oblivium *precedes* the attack of convulsion. What is the *cause* and *nature* of this momentary loss of consciousness?

1052. In one case, the patient frequently experienced a peculiar slight alteration in the *voice*, *before* the attacks, nay, many hours before the attacks. In another case the patient lost the power of singing certain high notes which he could easily accomplish before, *after* each attack. A spasmodic affection of the larynx has obviously much to do in this disease, as well as in the crowing inspiration or croup-like convulsion of infants; so much, indeed, that I doubt whether convulsion could occur without closure of this organ. Convulsion is frequently prevented for hours together by continuously watching the threatenings of it, and dashing cold water on the face. Now the action of cold water upon the trifacial nerve, affects by a reflex influence the opening of the larynx and an act of inspiration, and thus prevents the series of muscular actions which constitute convulsion, viz., closure of the laryux, forcible efforts of respiration, and general spasmodic contraction of the muscles. It is a singular idea, that *tracheotomy would effectually prevent the epileptic seizure.*

1053. Does such a spasmodic action take place in the muscles of the neck unnoticed, compress the veins which convey the blood from the brain, and induce the oblivium to which I have just alluded?

1054. There is a most important difference between epilepsy and hysteria. The former is amongst the most serious and intractable of diseases; the latter is comparatively of little consequence. What is the cause, the nature of this difference? Certainly, amongst other circumstances, that of the presence of closure of the larynx in epilepsy, and its absence in hysteria, is not the least important. It is this event in epilepsy, combined with the expiratory struggles, which fills the veins, and induces congestion of the nervous centres, with its terrific effects. It is the absence of these phenomena in hysteria, which is the cause of the little damage done to the nervous centres in this disease, even when most violent. Consciousness is obliterated in the former disease, but is only partially, if at all, impaired in the latter. What an important topic for investigation.

1055. I *must* add another remark. Compare the croup-like affection of infants,—a *laryngeal* affection, with *pertussis*,—a *bronchial* affection. The former readily passes into convulsion; the latter rarely, and then only from the same cause, viz., the violence of the expiratory efforts. Again I say, how much remains for fresh investigation. Compare the croup-like affection with asthma in adults; the former is a *laryngeal*, the latter a *bronchial asthma*; the former passes into convulsion, the latter *never*.

1056. These observations are made in order to excite attention to this subject. The space allotted to these lectures does not allow me to do more than give a mere sketch of the important inquiry in which I am engaged.

1057. Either as *cause* or *effect* of the epileptic seizure, the fæces are deficient in bile, and the urine is preternatural in quantity and appearance, being, in one case, profuse before, and turbid, with lithotic deposits, after the attacks.

1058. Before I quit the subject of epilepsy I must make one remark upon the similarity of its effects to those of *strangulation*. In *both* these cases there is suspended respiration, with convulsive efforts, congestion of the brain, insensibility, and, to complete the analogy, amongst the remote *effects* of strangulation, is convulsion itself, the tongue is protruded, the semen expelled. I must refer you, however, upon this subject, to an interesting case in the "Observations on Surgery," by the late Mr. Hey, of Leeds, ed. 4, p. 481.

1059. That the convulsions in strangulation are *excited* through the medium of the pneumogastric nerves, is rendered almost certain by comparing the effects of the privation of air in animals in which these nerves are left entire, and in others in which they are divided; the former *with*, the other *without* convulsions.

1060. That the pneumogastric nerve has much to do with these convulsions is indubitable. The difference between the effects of strangulation, and those observed in Sir A. Cooper's interesting experiments (§ 187, and "Guy's Hospital Reports," vol. i., p. 473) is, that in the former the circulation in the brain (with sensation, as I believe,) is annihilated, the centre of the excito-motory system being comparatively unaffected; whilst, in the latter, the circulation in the medulla oblongata, the centre of that system, as well as that of the cerebrum, is arrested. The function of the key-stone of the excito-motory arcs being destroyed, the phenomena, viz., the convulsions of the thorax, or limbs, observed in the other case, are absent.

1061. The effects of pinching the pneumogastric in a living animal, may be adduced in confirmation of these views. The pneumogastric is obviously an *excitor*, as well as a motor and ganglionic nerve.

1062. You will remember what I said on the subject of *secondary asphyxia*. The remedy is frequent, full inspirations, entirely to remove residuary carbonic acid in the lungs,—repeated until the danger is over. It has been observed that convulsive diseases occur in infants, especially during the sleep. In this state there is a *defective* respiration, the proportion of carbonic acid in the lungs is greater than in waking hours. May this be an exciting cause of the convulsions? If so, the remedy would be to excite respiration by gently disturbing the sleep, after the lapse of a certain time.

1063. I scarcely dare touch upon the phenomena presented by the generative system during strangulation by suspension. It is well known that those organs are excited, and that there are erection and emission of semen, in the male subject, and a uterine flow in the female. It is said that a recourse to a temporary suspension has been had by the sensualist. It is said that in this manner an unintentional suicide has been committed.

II.—Puerperal Convulsion.

1064. Nearly allied to epilepsy is puerperal convulsion.

I have no doubt that the mysterious phenomena of abortion and parturition, are phenomena of the true spinal or excito-motory system. The same remark may be made relative to the sickness and vomiting attendant on early pregnancy. To the same class of phenomena, also, belong the convulsions which occur in the *pregnant* and *parturient* states.

1065. The principal *causes* of puerperal convulsion, besides the peculiar condition of the uterus itself, are indigestible food, a loaded and morbid state of the bowels, a distended condition of the bladder, &c., and mental shock, or anxiety.

1066. This convulsion itself resembles epilepsy. It is preceded by a peculiar hissing inspiration. It is attended with great danger, the coma induced by it being deep, and the cerebrum obviously much affected.

1067. The following extracts from Dr. Denman's work on midwifery, are full of interest in reference to an exciting cause, and a mode of prevention of this species of convulsion:—

1068. "In a case published twenty-three years ago, when the os internum began to dilate, I gently assisted during every fit; but being soon convinced that this endeavour brought on continued, or increased the convulsions, I desisted, and left the work to Nature."

1069. "On every principle, of removing the cause of the convulsions, of substituting new modes of irritation, different from that which produced the convulsions, of preventing their ill effects, or of abating that exquisite irritability which renders patients subject to them, almost every measure and method has at one time or other been tried. *Harvey* recommended the irritation of the nose in a comatose patient, who was in labour, and gives an instance of its success. Many years ago I was led, by accident to try the effect of sprinkling or dashing cold water in the face; and in some cases the benefit was beyond expectation or belief; but in other cases in which I used this method with equal care and assiduity, no good whatever was derived from it.

1070. "I subjoin the following case, to explain the manner of using cold water. In a patient in convulsions, who had been bled, and for whom many other means had been fruitlessly used, I determined to try the effect of cold water. I sat down by the bedside, with a large basin before me, and a bunch of feathers. She had a writhing of the body, and other indications of pain, evidently occasioned by the action of the *uterus*, before the convulsions, and when those came on, I dashed, with some force, the cold water in her face repeatedly, and prevented the convulsion. The effect was astonishing to the by-standers, and, indeed, to myself. On the return of the indications of pain, I renewed the use of the cold water, and with equal success, and proceeded in this manner till the patient was delivered, which she was without any more convulsions, except once, when the water was neglected. The child was born living about fifteen hours from the time of my being called, and the patient recovered perfectly.

1071. "I was much mortified to find, that I had not discovered a certain and safe method of treating convulsions; further experience convinced me that this often failed. It is, however, a safe remedy, and though it may not always have sufficient efficacy to prevent or check convulsions, whoever tries this manner of using cold water will soon be convinced that it is a most powerful stimulant."

1072. *The* remedy is the most efficient bloodletting, and the removal of the causes. Dr. Denman observes: — "The late Dr. Bromfield informed me of a case of puerperal convulsions, for which he had bled the patient without much benefit. In the violence of some of her struggles the orifice opened, and a considerable quantity of blood was lost before the accident was discovered, but the convulsions from that time ceased." Of another patient he observes: — "She fell into labour; she became blind, and had one convulsion. Having great sickness at her stomach, without vomiting, I urged her to irritate her throat with her finger, by which means she vomited five or six times, and had no fit afterwards; the blindness remained in some measure for several days after delivery. The child had been dead about a fortnight." The bladder, the rectum, should be evacuated.

III.—On Tetanus.

1073. Tetanus has long been divided into idiopathic and the traumatic. I propose to divide it into the *centric* and the *eccentric*.

Centric tetanus is that produced by disease within the spinal canal itself. Eccentric tetanus arises principally from a wounded, lacerated, or punctured nerve, and possibly from other sources of eccentric nervous and convulsive affection, as deranged stomach, deranged bowels, worms, &c. It is, therefore, both traumatic and idiopathic.

1074. There is a predisposition to tetanic affection in hot climates; sudden changes of temperature, and exposure to cold and damp are exciting causes. In hot climates infants are subject to tetanus within nine days of their birth, as some have supposed, from the condition of the umbilicus.

1075. The spasms first affect the muscle about the neck; then those which approximate the maxillæ, and there is trismus; then the muscles of the pharynx, and the deglutition becomes difficult. The limbs and the whole frame become stiffened by spasm, which is still further augmented by the slightest touch, jar, or excitement. There is constipation. No one can fail to see that these are affections of the true spinal system. The cerebral system is unaffected. Baron Larrey observes:—"The functions of the brain remain unimpaired to the last moment of life, so that the unfortunate victim of this malady perceives himself to be dying."

1076. One fact is observable. The influence of the lesion of the nerve is not only carried by excitor nerves to the spinal axis, and *reflected* upon motor nerves, but it frequently pursues a *retrograde* course along the spinal marrow; a wound of the foot, not less than a wound of the hand, leads to trismus. A similar event occurs in experiments on the decapitated turtle. If one of the lateral nerves be laid bare, and pinched cautiously, the muscles of the upper extremities as well as the lower, are forcibly contracted. This is, in my mind, the very *type of tetanus*. The same retrograde action is produced, if, in a decapitated frog, the spine be divided, and the lower end of the upper portion of the spinal marrow be pinched with the forceps.

1077. As in epilepsy, no constant morbid appearances have been found in the cranium or spinal canal.

1078. In an interesting case of tetanus, given by Dr. Reid, in the "Transactions of the Association of Physicians in Ireland," vol. i., p. 113, great vascularity and an effusion of blood, were found round the spinal marrow. In another case, detailed by Mr. Brayne, of Banbury, in the "London Medical Repository," vol. xiv., p. 1, two or three inches of the inferior dorsal portion of the spinal marrow were suffused by a continuous blush of inflammation, and three small, hard, white laminæ were seen between the arachnoid and pia mater. M. Ollivier, on the other hand, shows that such morbid appearances are by no means constant; Dr. Abercrombie and M. Gendrin come to a similar conclusion.

1079. The treatment of tetanus is generally unavailing. Considering the cause of this malady, and its mode of operation, we should be naturally led to propose the division of the injured nerve, or amputation.

There is a successful case of the former operation in the "Medical Gazette," vol. xi., for 1832-3, p. 623. In reference to the latter, Baron Larrey observes, in his "Account of the Campaign in Russia,"—"With the exception of one only, all those affected with this cruel malady died. That one, being wounded in the foot, owed his preservation to the amputation of his leg, performed immediately on the invasion of the first tetanic symptoms. The amputation of the arm or leg was generally successful." These plans have not succeeded in the hands of other surgeons, perhaps from being adopted too late.

1080. I wish I had space for M. Dupuytren's admirable observations in his "Leçons Orales, t. ii. p. 599—612; they are full of interest. He advises that half-divided nerves should be completely divided. He is opposed to amputation as inefficacious when tetanus has actually commenced. He adds,—"The symptoms and the autopsy unite in demonstrating that tetanus is an idiopathic nervous affection, and without organic lesion."

1081. Bloodletting, opium, the hydrocyanic acid, tobacco, mercury, antimony, local depletion, purgative medicines, have been tried, with but occasional success. The cold bath has proved immediately fatal.

1082. The *principles* of treatment would appear to be—1, to divide the injured nerve; 2, to subdue the spasmodic affections, by such remedies as the hydrocyanic acid; 3, to prevent organic changes in the nervous system, by depletion, general and local; 4, to remove all sources of irritation, as scybalæ in the bowels, &c.; and, 5, to avoid all sources of augmented spasm, such as shocks, noises, &c.

IV.—On Hydrophobia.

1083. Another terrific disease of the nervous system, arising from causes acting at a distance from the nervous centres, is hydrophobia.

1084. A wound inflicted, a poison inserted, probably in the substance of the fine fibrillæ of excitor nerves, is the cause of this disease.

1085. After a variable interval, the peculiar symptoms of hydrophobia display themselves. All these symptoms obviously belong to the true spinal or excito-motory functions; they consist in a peculiar spasmodic and terrible *dysphagia* and *dyspnœa*. The parts immediately affected are those which preside over ingestion.

1086. The fifth nerve in the face and in the fauces, and the pneumogastric in the larynx, appear to be most unduly impressible. The impression upon these nerves is reflected upon the muscles of the pharynx and larynx, and the sense of dysphagia, or of dyspnœa, is overwhelming. The slightest motion in the atmosphere, the application of a glass or cup to the lips, the sight or idea of water, or other fluids even, are attended by an agony of suffering,—of mingled spasm, choking, strangulation, and terror.

1087. There are, from the first, extreme anxiety of the countenance and inquietude of manner, and a peculiar aggravation of these appearances at the sight of fluids, or on feeling a gust of air pass over the face, and still more on attempting to drink; by any of these causes an expression of horror, a sense of suffocation, with constriction about the throat, and convulsive movements, are produced, which are terrible to witness, and beyond description. Independently of these causes, there are similar symptoms, only in a minor degree. Later in the disease, the agony of expression and suffering is extreme; viscid saliva forms and collects in the mouth, and is removed with impatience and horror, and spasm about the throat; the mind begins to wander with a terrible delirium; the limbs are moved with continual spasm and agitation. At length the powers of life and of the disease sink together.

1088. M. Gendrin, in a note to his translation of Dr. Abercrombie's work, ed. 2, p. 578, remarks,—"I have observed several cases of hydrophobia, and have assisted at the examination of still more; only a few months ago I followed this horrible malady from the first symptoms until its fatal termination. I have never seen the slightest trace whatever of inflammation, or of lesion in the cerebro-spinal organs, or in the ganglionic nerves. The only lesion which I have recognised is a considerable development, generally inflammatory, of the mucous follicles at the base of the tongue, in the pharynx and the superior orifice of the larynx. Patients affected with hydrophobia die asphyxiated; after death, as in cases of tetanus, a marked degree of congestion is found in the pulmonary veins; a general state of congestion of the principal viscera, and particularly of the brain, and liquid blood of an obscure red in the vessels."

1089. The treatment of hydrophobia has hitherto been abortive; every remedy which the terrors of the disease, or the ingenuity of physicians could suggest, has been tried in vain. Dr. A. T. Thomson's case was apparently mitigated by the hydrocyanic acid. Mr. Mayo has ingeniously suggested the propriety of tracheotomy. If a case were committed to my charge, I would combine these two modes of treatment. The strychnine might induce tetanus, or hydrophobia, but can never cure it, except upon a principle of similia similibus.

V.—Hysteria.

1090. Vast, indeed, is the distance which separates hysteria from epilepsy, yet how *similar* are the symptoms of these two dis-

eases. There is *one* great distiuction,—in hysteria, much as the larynx may be affected, it is never closed; in epilepsy it is closed; in the former we have heaving, *sighing*, *inspiration*,—in the latter *violent*, *ineffectual efforts* at *expiration*; in the former the cerebrum, the true spinal marrow, are comparativcly unaffected; in the latter they are in a state of apoplexy and of irritation.

1091. Hysteria frequently depends upon the state of the stomach and bowels; still more frequently, as its designation implies, and like epilepsy, it arises from various conditions of the uterine system; and very frequently it is connected with the state of the mind and emotion,—*cause* and *effect*.

1092. Some seem to imagine that hysteria is a *feigned* disease,—this it is not; it is *real* enough, but it is generally *exaggerated*. This is, I believe, the true view of the matter; to this the peculiar condition of the mind seems to give origin.

1093. Hysteria seems to single out and affect every organ, every function which belongs to the true spinal system. Like the emotions it also affects the action of the heart, the secretions, especially that of the kidney, &c. I will merely add, in this place, the following table of the parts obviously under the dominion of the true spinal marrow, which are affected in this multiform disease:—

1. *The larynx*,—imitation of croup; apparently imminent suffocation.
2. *The pharynx*,—dysphagia.
3. *The respiratory organs*,—dyspnœa, cough, hiccough, retching, and vomiting, &c.
4. *The cervix vesicæ*,—dysury, retention.
5. *The muscular system*,—trismus, tetanus, contracted hand, distorted foot, twisted legs, &c.

The rest relates to emotion, which is the magna pars of hysteria, as hysteria, in its turn, is in the deluded and the deluding, the magna pars of Mesmerism, animal magnetism, or by whatever other ridiculous term so ridiculous a thing may be named.

VI.—Chorea.

1094. Chorea is distinctly an affection of the true spinal system; it affords an example of the want of harmony between the cerebral and the true spinal acts; the *volition* is normal; the true spinal action is abnormal. The *action* is abnormal, or irregular, for want of a precise harmony between the two.

1095. It is by acts of volition that the acts of the true spinal system are called into play: it is, therefore, when volition is excited, that the chorea is most distinctly manifested. The articulation and all the voluntary movements are irregular and impaired; the same thing is observed on any emotion. During sleep and repose, on the contrary, the chorea is mitigated, or disappears altogether, especially in the early stage.

1096. That chorea is excited through a morbid state of the bowels, there can be no doubt; it ceases frequently on removing this disorder. It involves, however, a morbid condition of the true spinal system, which certain tonics, and especially the arsenicum and the carbonas ferri, remove. It is, however, in the beginning not a centric, but a centripetal disease.

1097. Chorea frequently assumes a hemiplegic character; that is, it affects one side more than another; it also passes on from irregular motions to a sort of paralytic weakness; and eventually the mind, as well as the limbs, becomes enfeebled. Like some other true spinal diseases, centripetal in their origin, chorea becomes centric and cerebral in its course before its fatal issue.

VII.—Stammering.

1098. Stammering is very like a very partial chorea; it is not, I think, as Dr. Arnott supposes, an affection of the glottis, that is, of the organ of the *voice*, but of some of the different parts which constitute the machinery of *articulation*. For a disquisition on this point, I refer you to the Journal of the Royal Institution for Feb. 1831; I have there given my reasons for adopting a different view from that of Dr. Arnott, and have explained the various forms of stammering on the principles of the physiology of the articulation of the different orders of letters.

1099. In stammering, in fact, the act of volition is rendered imperfectly an action, independent and subversive of the will, and of true spinal origin. In some instances an act of *inspiration* is excited at the same time, which is equally involuntary.

1100. Stammering, as a disease, is sometimes induced by a morbid condition of the intestines, acting through the incident nerves. Dr. Bostock has recorded such a case in the "Medico-Chirurgical Transactions," vol. xvi., p. 72; it was cured by purgative medicines.

1101. In all cases this affection is aggravated by indisposition and by emotion or agitation. It is best remedied, when not hereditary, or inveterate, by attention to the general health, and especially by purgative and tonic medicines, and by acquiring a habit of self-possession, and of speaking in a subdued, continuous tone, first dilating the thorax.

1102. I had one interesting case in which *attacks* came on from time to time, of a peculiar loss of speech; on attempting articulation the patient drew an inspiration, making a hissing noise between the lips, and suffering acute pain around the false ribs, about the insertions of the diaphragm.

LECTURES

ON THE

NERVOUS SYSTEM AND ITS DISEASES.

BY MARSHALL HALL, M.D., F.R.S., &c. &c.

[From The Lancet, April 21st, 1838.]

XII.

Diseases of the Nervous System.—*Spasmodic asthma; its simplest form. Symptoms and treatment of this species. Action of ipecacuan on the bronchia. Peculiarities produced by idiosyncrasy. Instrument for rapidly performing tracheotomy. Vomiting; it is a reflex, spinal, act. Mechanism of vomiting. Opinions of M. Magendie, and other physiologists, examined. Œsophageal vomiting. Abortion. Spasmodic strabismus.*

Gentlemen:—In the present lecture I bring to a conclusion the Nervous System and its Diseases; yet, how much remains unsaid. I have thought it right, however, not to occupy your attention unduly with a favourite subject. As I proceed in my investigations, I propose to lay the results before the profession as they may be established, so that your future reading will supply any defect in what you now hear.

1104. I proceed to treat of several other centripetal diseases of the true spinal system. I shall then lay before you some observations upon several affections which may very justly be designated centrifugal. You will remember I am not the first to employ these terms in medical language. I might have hesitated to do so; but with the example of Prof. Müller before me, I need not hesitate to use these very significant terms.

1105. The first subject of which I now propose to treat briefly is

VIII.—Spasmodic Asthma.

I have already alluded to this subject.

The similarity between the croup-like disease, or the laryngeal asthma, and this, or the bronchial asthma, is most marked. A morbid state of the stomach induces both; both come on in attacks, and in the first sleep; both cease, as by a charm, from change of air; both are instances of reflected irritation: the difference consists in the closure of the larynx in the former disease, and its open state in the latter, a difference which is probably the cause of all the other differences between these two diseases.

1106. The simplest form of asthma is that immediately induced by taking some indigestible substance; or, perhaps, still more immediately induced by the inhalation of certain kinds of dust diffused in the atmosphere, as that raised by shaking a feather-bed, the powder of ipecacuanha, &c. The incident branches of the pneumogastric, or internal excito-motory nerve, are excited; the action is reflected by the medulla oblongata upon the motor branches, and, as I believe, upon the circular muscular fibres of the bronchial tubes. These tubes are contracted, and the phenomena of asthma are induced. A constipated state of the large intestine acts in the same manner through the incident spinal nerves. Contracted bronchial tubes explain all the phenomena: the dyspnœa, the urgent, rapid, imperfect bronchial inspiration; the protracted wheezing bronchial expiration; the bronchial rattles under the stethoscope, especially during expiration; the excited secretion of mucus, the cough; ultimately, the dilated air-cells, the dilated heart, &c.

1107. As certain additions to the atmosphere induce asthma, so certain others, as the smoke of tobacco, of stramonium, relieve the disease, and upon similar principles. As asthma is a morbidly excited state of the true spinal nerves, so remedies which subdue the action of that system, as the hydrocyanic acid, constitute our most prompt remedies in this disease. Swallowed, or inhaled, this remedy is invaluable, in this and in the cognate diseases, as the croup-like disease, pertussis, &c., &c., the first exciting cause or causes being removed.

1108. How singular is it, that ipecacuanha, taken into the bronchia should excite asthma, and taken into the stomach should induce another affection of the respiratory

system, vomiting. How does every step in this inquiry lead to new comparisons, new illustrations of disease. How short-sighted have been its soi-disant critics, its incapable judges.

1109. You cannot mistake asthma; remember that its attack is generally sudden; frequently in the first sleep. Trace it to its immediate cause; if this be an indigestible meal, give a mild emetic; if a morbid state of the intestines, give the warm water enema and a brisk purgative; if a north-east wind, or a dry atmosphere, imitate the genial south-west by diffusing warmth and moisture through the patient's room. A fomentation to the chest often does great good. Have recourse to the other remedies which I have mentioned; and then guard the patient against future attacks by teaching him to avoid its causes.

Some patients can breathe in London who cannot in the country; some in the country who cannot in London; some can breathe in the lowest room who cannot in the highest stories. Ascertain these peculiarities, and propose the plans which they suggest to you. I need not say how important it is to avoid the attacks of asthma; the mere momentary suffering of the attack is nothing compared with the emphysema of the lungs, the disease of the heart which repeated attacks induce.

1110. I must close these cursory remarks by one or two observations. Sudden death frequently occurs in cases of affections of the larynx, or the upper part of the trachea, during the operation of tracheotomy. The fear and sufferings of the patient add to the excito-motory actions of the larynx, and induces asphyxia. How important would be some more prompt mode of performing this operation. Such a plan I proposed long ago; it is to remove a portion of the integuments and of the trachea, at once, by a small steel cylinder, with cutting edges and a piston. Of this I gave a description to Mr. Weiss some years ago; the proposition has been allowed to remain dormant. Another observation is this: there is a case on record, and I think in the "Edinburgh Medical and Surgical Journal," in which a shot passed into the trachea, and eventually into a bronchial tube, as a person was drinking out of a bottle, which had been cleaned, as is usual, with shot; it induced asthma. This asthma ceased at once on one occasion, when the patient expectorated the shot. The rationale of this case is perfectly obvious to those by whom the actions of the true spinal system are understood.

Lastly: in some cases of chronic bronchitis we observe phenomena similar to those of the asthmatic seizure.

1111. In confirmation of the views given on this subject, I propose to make a series of experiments to ascertain the power of muscular action on the bronchial tubes, by the immediate and reflected action of galvanism. A glass tube will be fixed in the trachea, and this will be placed in blood-warm water; galvanism will then be passed through the water, and through the excitor and motor nerves.

1112. The next subject which I must introduce to your notice is that of

IX.—Vomiting.

No subject illustrates the special function of the true spinal, or excito-motory system so admirably. It is singular that Professor Müller, in his account of the actions of the pharynx, and of the sphincter ani, and of vomiting, does not once allude to these phenomena as being reflex and spinal, so little did this most acute physiologist understand of this subject before the publication of my Researches. The same remark may of course be made relative to the works of Mr. Mayo, M. Magendie, &c.

1113. I shall distribute my remarks on vomiting in the following manner:—

1. *Of Vomiting, as a reflex, spinal, Action;*
2. *Of the Mechanism of Vomiting;*
3. *Of Œsophageal Vomiting.*

I shall begin, then, by treating of

1. *Vomiting, as a reflex, spinal, Act.*

Professor Müller speaks of the nerves of the pharynx as those through which vomiting may be excited. This is a mistake; it is through branches of the trifacial distributed to the fauces that this act is excited, on touching these parts with the finger, a feather, &c. This fact I have proved by experiment. A friend of mine touched the fauces with an ivory knife; it immediately induced an incipient act of vomiting. He then carried the knife backwards, so as to touch the posterior part of the pharynx; no effect whatever was induced. A feather carried further down, instead of inducing vomiting, has actually been swallowed.

The velum pendulum palati, and points on the anterior and posterior parts of the tonsils are particularly excitable.

A singular effect is amongst the first phenomena observed. The cardia opens distinctly, and a little gas escapes into the œsophagus. Then the larynx closes, and the other associated movements of vomiting take place.

A disagreeable object seen, the motion of a ship at sea, or of a swing, a blow, or fall on the head, seem to act through the medium of the medulla oblongata; certain emotions probably do, the last by a sort of contre-coup.

In vomiting excited through the fauces, it is the trifacial which is the nerve of transmission; in vomiting induced by an emetic, by a renal calculus, or a gall-stone, it is the pneumogastric; and in the vomiting of early pregnancy or dysmenorrhœa, it is a spinal nerve which is the incident excitor nerve.

All those nerves convey the excitement ultimately to the medulla oblongata. This combines the action of the nerves which regulate the aperture of the cardia, the closure of the laryux, and the acts of expiration; but of this I propose to treat under the head of

2. *The Mechanism of the Act of Vomiting.*

1114. Two opinions have divided physiologists respecting the mechanism of the act of vomiting. It was originally and long thought that this act consisted simply in a suddeu and forcible contraction of the stomach itself. Afterwards Bayle and Chirac, and more recently M. Magendie, cousidered that the stomach is inactive, and evacuated by being subjected to pressure by the simultaneous contractiou of the diaphragm and abdominal muscles. It appears to me that neither of these opinions is correct. M. Magendie distinctly proves, by actual observation, nnd by the substitution of a bladder in the place of the stomach, that the contraction of this organ is not usually subservieut or nccessary to the act of vomiting. I refer to the interesting paper (Paris, 1813) of that eminent physiologist for the more full elucidation of this first question. I proceed to state such observations as appear to me to controvert the second, and to establish that view of this subject which I have myself been led to adopt. It is obvious, that if vomiting were effected by a contraction of the diaphragm, it must be attended by inspiration. If this were the case, the fluids ejected from the stomach would be drawn into the larynx and induce great irritation, eveuts which have not been observed. These events are, indeed, effectually prevented by an accurate closure of the larynx, a fact observed in an actual experiment by M. Magendie, who makes the following observation :—" Dans le vomissement, au moment au les matièrs vomies traversent le phnrynx, la glotte se ferme très-exactement." It is astonishing that this observation did not lead its acute author to see that, under such circumstances, a contraction of the dinphragm, unless the thorax followed precisely *pari passu*, was impossible. Complete vomiting has been observed, too, in cases in which the stomach had entirely passed through a wound of the diaphragm into the thorax, and in which it could not, consequently, be subjected to the action of that muscle. In some experiments, vomiting was observed also to take place, although the diaphragm had been paralysed by a division of the phrenic nerves, or its influence substracted by a division of its anterior attachments.

1115. This view of the subject is still further confirmed by facts, which I now proceed to state, which prove that the act of vomiting is an effort, not of inspiration, but of expiration. This is obvious enough, indeed, on a mere observation of the states of the thorax and abdomeu during vomiting. The larynx is evidently abruptly and forcibly closed, the thorax drawu dowuwards, and the abdomen inwards.

Such, indeed, appears to me to be the precise nature of the act of vomiting, in ordinary circumstances. The contents of the thorax and abdomen are subjected to the sudden and almost spasmodic contraction of all the muscles of expiratiou, the larynx being closed so that no air cau escape from the chest, and the two cavities being made one by the floating or inert condition of the diaphragm.

The mere mechanism of the act of vomiting differs little, therefore, from that of coughing, by which, iudeed, the contents of the stomach are frequently expelled: the larynx in the former is, however, permanently, in the latter only momentarily closed; and there is, doubtless, a different condition of the cardiac orifice and of the œsophagus.

1116. It appeared to me from these views of this subject, that if an opening were made into the trachea, or through the parietes of the thorax, the effort of expiration constituting the act of vomiting would issue in expelling the air through these orifices respectively, and the evacuatiou of the stomach would be prevented, and I determined to submit the fact to the test of experiment. I took a little dog, made an ample opening into the wind-pipe, and gave a few grains of the sub-sulphate of mercury; the animal soon became sick. The first efforts to vomit induced a forcible expulsion of air through the orifice in the trachea. These efforts soon became very violent, however, and the stomach at length yielded part of its contents. It was perfectly evident that the violent contractions of the abdominal muscles pressed upon the viscera of the abdomen, so as to carry the diaphragm upwards to its fullest extent, and at this moment vomiting was effected. The act of expiration was so forcible that a lighted candle placed near the tracheal orifice was several times extinguished. In a second experiment a free opening was made into the thorax between the sixth and seventh ribs of the right side. the lung collapsed partially only. During the first efforts to vomit, air was forcibly expelled through this orifice, the lung was brought almost into contact with it; the stomach was not evacuated, but as the efforts to vomit became extreme, a portion of lung was driven through the thoracic opening with violence and a sort of explosion, and at the same instant the stomach yielded its contents.

1117. These experiments appear to admit only of one explanation, of one conclusion, that the act of vomiting is a forcible expiratory effort, the larynx being firmly closed, and the diaphragm perfectly inert. It must

be regarded as singular that M. Bourdon, by whom the action of the expiratory muscles, in their various "efforts," has been so well investigated, should have adopted other views of the act of vomiting.

1118. It is not intended to state, that the act of vomiting is simply such as I have described. There ure many facts which appear to show that the œsophagus is not without its share of influence in this act, and it is plain that the cardiac orifice must be freely opened, for mere pressure upou the viscera of the abdomen will not, in ordinary circumstances, evacuate the contents of the stomach. To effect this open state of the cardiac orifice it is probably necessary that the diaphragm should, indeed, be in a relaxed rather than in a contracted state.

1119. A singular and interesting fact was noticed by M. Magendie, of which he has given no explanation. During the state of nausea which preceded the act of vomiting in some of his experiments, air was drawn into the stomach. I am disposed to think that this effect was produced in the following manner:—The larynx being closed preparatorily to the act of vomiting, an attempt at inspiration is made before the effort of expiration. In this attempt air is drawn into thc œsophagus, the larynx being impervious, and it is afterwards probably propelled along that canal into the stomach itself; it is not improbable, too, that in some instances of vomiting, in which the action of the abdominal muscles was subtracted, a similar effort of inspiration has drawn substances from the stomach into the œsophagus which has eventually expelled them by an inverted action. Neither of these phenomena could result from any action of the diaphragm, and much less from contraction of the abominal muscles; but it is easy, by closing the larynx and attempting to inspire, to draw air into the œsophagus. A similar act, if very forcible, might draw a portion of the contents of the stomach through the cardiac orifice.

Such then, I think, appears to be the nature of the act of vomiting. How different is this act from one in which the diaphragm does indeed contract suddenly under similar circumstances of closure of the larynx, viz., singultus, the action of the diaphragm being an effort of inspiration; air is apt to be drawn into the œsophagus with considerable noise, and there is occasionlly pain, not only about the insertion of the diaphragm, but about the closed larynx.

1120. Since the publication of the preceding remarks in the "Quarterly Journal of Science" for June, 1828, I have been greatly interested by the following extract from the valuable report of cases in the Meath Hospital, just published by Drs. Graves and Stokes, in the fifth volume of the "Dublin Hospital Reports and Communications:"—

"A man about 40 years of age died of tubercular phthisis.

"The œsophagus, after passing through the usual opening in the diaphragm, was found to re-euter the thorax by another very large opening in the tendinous portion towards the left side. The stomach occupied the iuferior portion of the left thoracic cavity, its cardiac and pyloric extremities both lying in the opening.

"The man vomited frequently while under observation iu the hospital. Now, as the stomach was placed entirely out of thc reuch of being compressed by the contractions of the diaphragm, and as this contraction completely defended it from the influence of the abdominal muscles, it is cleur that, in this case, vomiting must have occurred independently of compression, either of the diaphragm or of the abdominul muscles. This fact, worth a thousand experiments, completely decides the question, that vomiting may be produced by the action of the stomach itself, unassisted by any external compressing force, notwithstanding what Legallois and late physiologists have said to the eontrary."—Page 85—87.

1121. The anthors of the report do not appear to have seen the paper which I pnblished in the number of the journal of the Royal Institution for April to July, 1828, the object of which was—first, to expose the fallacy, both of that view of the nature of the act of vomiting, which refers it to a contraction of the stomach itself, and of that other view lately advocated by M. Magendie, which refers this act to the simultaneous contractiou of thc diaphragm and abdominal muscles; and, secondly, to propose a new view of this disputed question. As this last view has never been controverted—as it has, on the other hand, been generally admitted—and as it alone explains the various difficulties which beset each or both of the other two, it may not be amiss to reproduce its broad outlines here, in connection with the interesting case of Dr. Graves and Dr. Stokes. They are these:—During the act of vomiting

1. The *larynx* is *closed;*

2. The *cardia* is *opened;* and,

3. All the muscles of *expiration* are called into action; but,

4. Actual expiration being prevented by the closure of the larynx, the force of the *effort* is expended upon the stomach, the cardia being open, and vomiting is effected.

1122. It is plain, from this view of the subject, that the thorax and abdomen become one cavity, as it were, the diaphragm lying loose and inert between them. It is also obvious, that it is quite indifferent ou which side of the diaphragm the stomach may be placed, whether above, as in the case of hernia, or below, in its natural situatiou.

1123. The view of the act of vomiting which I have taken, appears to me to be

the only one which at once explains this act, as it occurs in the case of hernia of the stomach through the diaphragm, such as the one detailed by Dr. Graves and Dr. Stokes; and the experiment of M. Magendie, in which a bladder was substituted in the place of the stomach. The first establishes the fact, that the diaphragm, the second, that the stomach has no necessary part in vomiting. It remained, therefore, to show in what other manner the act of vomiting, and both of these facts, would admit of explanation. This is done in the manner already detailed; and the truth of the explanation is proved by two decisive experiments, related in the paper to which I have already referred. See § 1116.

1124. The next point I must treat of is that of

3. *Œsophageal vomiting.*

I have recently had an opportunity of watching the effort to swallow and the effort to vomit, in a patient with total obstruction at the cardia.

The effort to swallow was not to be distinguished from that in health, nor could the patient detect any difference, until the œsophagus being completely filled, the fluid ceased to descend beyond the pharynx, and flowed out of the mouth. The effort to vomit was also perfectly similar to that which takes place in health; the larynx was closed, an effort of expiration was forcibly made, and the fluids in the œsophagus were expelled as in ordinary vomiting.

1125. The stomach-tube was introduced repeatedly; whenever it reached the cardia, and so extended the œsophagus, an effort to vomit uniformly took place, as in the experiments of Legallois; at the same moment the fluids contained in the œsophagus were forcibly expelled through the tube.

1126. The whole of the phenomena in this case afforded an interesting confirmation of the views I had published on the mechanism of the act of vomiting, in 1828. In ordinary vomiting the abdomen and thorax become as one large cavity, the intervening diaphragm floating perfectly loose and inert between them, whilst the cavity of the stomach and of the œsophagus become equally one by the free opening of the cardia; an *effort of expiration* then takes place, and the stomach is evacuated through the œsophagus.

X.—Tenesmus and Strangury.

1127. I had recently a most interesting case of spasmodic stricture of the sphincter ani. The finger could scarcely be introduced. It was discovered that a calculus existed in the urethra; when this was removed the stricture immediately ceased.

1128. There is no fact so familiar as the retention of the urine produced by a ligature applied to hæmorrhoids; the cause and effect are removed together.

Tenesmus almost always implies the existence of strangury, and strangury that of tenesmus. They induce each other; they are *similar excito-motory* phenomena, affecting the exits of two organs.

Teething in children has produced both these actions, through a more remote arc of the true spinal system.

The last subject which I shall mention under this head is

XI.—Abortion.

1129. I have a number of facts which prove that abortion is frequently an excited act, excited through the spinal nerves of the rectum, and that its prevention depends upon removing and avoiding the causes of this excitement.

A frequent cause is a morbid and exciting state of the contents of the rectum. The death of the fœtus is another cause; as a foreign body it excites the contraction of the uterus.

The difference between the excited acts of the rectum and bladder, and of the uterus, is that in the latter the expulsors, the sphincter or the cervix, in the former, are the active organs excited to contraction; in the former the excernenda are frequently retained, in the latter they are expelled.

1130. I now proceed to notice another subdivision of these diseases, or

III.—The Centrifugal Diseases,

if this term may be allowed.

They are diseases of the reflex motor nerves.

1131. Spasmodic affections may arise from causes affecting the *excitor* nerves, the *spinal axis*, or the *motor* nerves of the true spinal or excito-motory system; the first and second have been noticed already. It now remains for me to treat of the third. The first of these is—

I.—Spasmodic Strabismus.

1132. I have already noticed the strabismus which arises from *paralysis* of cerebral and voluntary nerves, and some of the muscles of the eyeball. I now wish to draw the reader's attention to another form of strabismus, not hitherto distinguished from the former, and which I believe to be an affection of the motor nerves of the true spinal system.

1133. In the former case the patient can frequently move the eyeball fully, in every direction except one; at a certain point the eyeball stops, although the other eye continues to pursue an object placed and moved before it. This is the case with a patient at this moment under my care for attacks of sickness, with defective vision and motions of the eye.

1134. In spasmodic strabismus the motions of the eye may be perfect, except on certain occasions of excitement, or of disorder, or of intense application or of em-

ployment of the eye; the strabismus then becomes apparent, the eyeball obviously is *drawn* in one particular direction.

1135. In one interesting little girl, aged about three years, the strabismus came on whenever a stranger came into the room, whenever she was asked to read, &c.

II.—Spasmodic Tic.

1136. The next of these nerves is the *seventh*, or *facial*. So long ago as the year 1817, I published, in the "Edinburgh Medical and Surgical Journal," an interesting case, which is plainly one of spasmodic affection through this nerve:—

1137. Miss Inman, aged nineteen. Two years ago, in the winter season, the face became affected, during the course of one night, in the following manner: all the muscles of the right side of the face were drawn into a state of spasmodic contraction; the sensibility of the skin became much impaired, the contact of an external object inducing a feeling of numbness; there were a degree of swelling, and considerable pain; and a sense of rigidity was felt in the muscles of the right side of the neck.

1138. The muscular contraction was permanent, and very considerable; the right angle of the mouth was drawn downwards; the retraction of the integuments, the effect of muscular action, and usually observed extending from each nostril obliquely downwards, is, on the right side, very deeply marked; on the left it is seen in its natural state. The tongue, when protruded, is drawn a little towards the right side; the point of the nose is considerably so. The right eyebrow is drawn a little lower down than the left one; and two small dimples, the effect and evidence of muscular contraction, are seen immediately above it. A dimple in the chin is also distinctly marked, and is drawn considerably to the right of the mesial plane of the face. Articulation was, at first, very indistinct, and is still so in some degree; the letter *S*, especially, is pronounced with difficulty, and participates in the soft sound of *th*. There is no difficulty in deglutition; but considerable inconvenience occurs during mastication, from a tendency of the bolus of food to pass and collect in the right side of the mouth. On closing the right eye a degree of tightness is induced and felt at the right angle of the mouth; this tightness is *seen*, even when the patient speaks with the right eye perfectly closed. On drawing down the right angle of the mouth, by an effort of the muscles of this part of the face, the upper eyelid of the right eye is also drawn sensibly downwards, and the eye is partially closed. In the first instance the eye was closed with difficulty.

1139. The state of contraction of the muscles is seen much more distinctly, and the deformity induced is much greater, on speaking or laughing, than when the patient is in a state of tranquillity.

1140. At present the contraction of the muscles is much less than at first; the sensibility is perfectly restored. The diminution of the symptoms took place during the administration of electricity, the operation of blisters, and the exhibition of an emetic, followed by purgative medicines.

1141. This affection was considered by the patient as an effect of cold. The swelling and pain were deemed an attack of toothach, but without reason, as there is no decay of any of the teeth. Before and about the period of attack, pains were experienced in both arms and wrists, and were considered rheumatic. During two years previously to the accession of the affection described, this young lady had experienced some general indisposition, having been feeble, nervous, and subject to difficulty of breathing and palpitation of the heart. The catamenia had been somewhat irregular. The ankles were affected with œdematous swelling in the evening of each day.

1142. This case is deemed particularly interesting, as it establishes a distinct diagnosis between a *spasmodic affection*, and a case very similar in appearance, consisting of *paralysis* of one side of the face, a distinction which, it is thought, has been sometimes neglected. A further diagnosis, to which the practitioner must attend, consists in the distinction between a primary paralysis of the muscles of one side of the face, occasioned by the agency of internal causes, and a secondary paralytic affection, the consequence of pressure external to the brain.

1143. In the "Annuaire Medico-Chirurgical des Hôpitaux," published in 1819, there is (p. 406), an interesting case of a wounded facial nerve:—

1144. "On the 27th of February, 1814, Charles Leroux was wounded at the battle of Bar-sur-Aube. The ball struck him, from the distance of fifteen paces, on the left side of the face.

1145. "He felt but slight pain at the instant he received the wound. The only consequences which followed were a trifling swelling of the cheek, with a slight alteration in vision, shooting pains in the eyes, and a peculiar sensibility accompanying the act of mastication. Twelve days after the accident the wounds were completely cicatrised.

1146. "The most extraordinary circumstance of this case is, that when this man attempts to speak, laugh, or eat, in fact, whenever it is necessary to move the jaws, the sub-labial muscles contract involuntarily, and as if by sympathy. While the jaws are at rest, these muscles appear to be in their natural state, and the face offers no traces of change; but no sooner are the jaws moved, though very slightly, than the act is

accompanied with the most frightful grimace, of which the patient is unconscious. The countenance changes and becomes hideous, and it is hardly possible to recognise it. This alteration of the features is much greater on the left than the right side of the face. This phenomenon may, I think, be explained by the lesion of the sub-orbitar nerve. With regard to the sensibility accompanying the mastication, which, a month after the accident, was still felt, it must be attributed to the passing of the ball through the sub-maxillary alveoli, and to the shock resulting from it."

1147. For my own part, I do not pretend to have understood the case, which I have given § 1137, and which I observed and detailed merely as one of clinical observation and diagnosis. M. Beauchêne, the author of the second case, is absolutely in error in considering it as an affection of the sub-orbitar nerve.

I now lay before you a sketch of this spasmodic tic :—

1148. In this case the countenance is also drawn to the right side; but it is the eye of the *same* side which cannot be closed. It is distinguished by this circumstance. from *paralysis* of the facial nerve of the left side. In this there is a *spasmodic* affection of that nerve on the right side. It is a peculiar affection not discriminated from the former, and will be illustrated by the following case :—

1149. George Jefferson, aged forty, formerly a lamplighter, now a seller of fruit in the streets, was affected three years ago with general rheumatism, in the midst of which this singular affection of the muscles of the face came on.

1150. The two sides of the face are not alike; the left is nearly natural, but the right is affected with spasmodic contraction; the chin is drawn to one side and dimpled; the right angle of the mouth is drawn downwards; the right eyebrow is higher than the left. Sometimes there is a little rapid spasmodic action of the muscles.

1151. When he is told to shut the eyes promptly and forcibly, the distortion is tenfold; the right eye is drawn and only partially closed; the right angle of the mouth is drawn spasmodically downwards; the nose and the chin are drawn to the right side.

1152. He laughs, and bites perfectly on the left side. On attempting to open the mouth wide, it is obviously *tied* by the muscles of the right side. He cannot whistle; in the attempt to do so the mouth is drawn to the right side.

1153. He takes snuff through both nostrils indifferently; on sneezing, the left side of the face is chiefly distorted.

1154. The right side is a little benumbed in feeling; it is also colder, after exposure to cold, than the left.

1155. Besides these two cases I have seen several others; in one there was a defect of vision, with the spasmodic tic; in another the tic was confined to the outer portion of the orbicularis. The former was of the most extreme character; the fac

being exceedingly distorted on each spasmodic attack. The latter was comparatively slight. The former probably arises from disease of the facial nerve *within* the cranium,—the latter appears confined to that branch of the facial *exterior* to the cranium, which supplies the orbicularis

1156. The *causes* of this affection are the usual causes of inflammation; the most frequent is exposure to a keen wind, either extremely cold, or with rain, or sleet,—a *coup de vent*, as it is termed.

1157. The remedies for this disease are unknown; in the severer case just mentioned, aperients and mercury have been fully tried in vain. I have proposed local depletion and counter-irritation, by means of the cupping instruments.

Recently I have seen great benefit accrue from the use of fomentations, and of liniment, and especially from a liniment containing the hydrocyanic acid.

1158. Before I leave this subject, I must say a few words upon *distortions* of the face in general; these arise from paralysis, and this may have its seat in the cerebrum, or in the facial nerve.

1159. The former of these is represented in the subjoined woodcut (Fig. 1):—

Fig. 1.

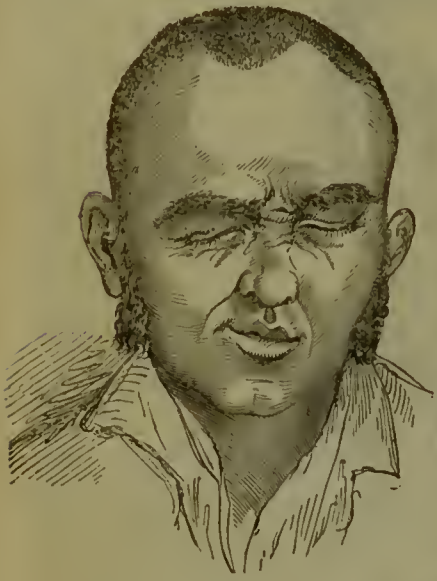
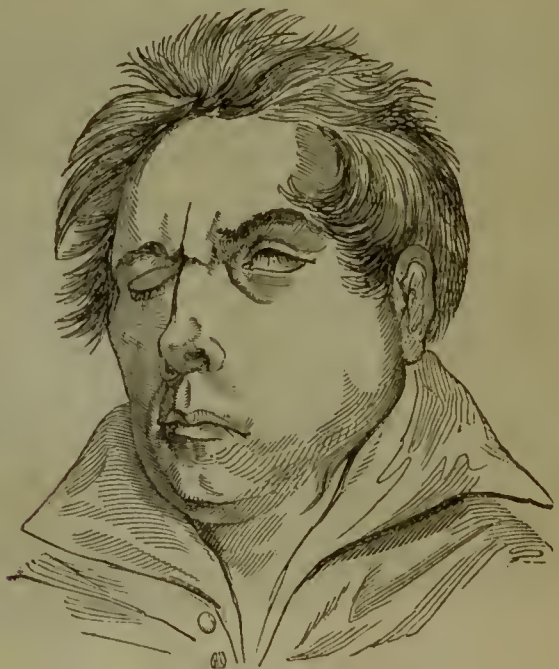


Fig. 3.

Fig. 2.



The eyelids of the right, or paralytic side, are closed by an act of volition, although not so perfectly as those of the unaffected side; the *sensibility* is generally diminished: the tongue is protruded *towards* the paralytic side, by means of the contraction of the unaffected side of the genio-hyoid muscle.

1160. Compare with these the cuts which I now present to you.

The first represents the seventh, or facial nerve, compressed by a tumour under the ear; the orbicularis is paralysed, and the patient is incapable of closing the eyelids. (Fig. 2.)

1161. The second is a representation of a similar affection in an infant; its mother observed, "it laughs and cries on the *right* side, and cannot close its *left* eye." (Fig. 3.)

1162. The *diagnosis* of these cases is most important, and I think you cannot fail in this point.

Spasmodic Torticollis.

1163. This spasmodic affection of the sterno-cleido-mastoid muscle has long been known to physicians. It is obviously of the same character as the spasmodic strabismus, and spasmodic tic—an affection of the *true spinal motor* nerves.

The following interesting case was communicated to Sir Charles Bell by Dr. Knight:—

"Sir,—About December, 1827, Master —— was seized during the night with a stiff neck; it excited little attention: he played with his schoolfellows as usual, some of whom playfully but rather rudely twisted his head in contrary directions. When he returned home at the Christmas holidays I was requested to see him. I found his general health very much deranged, and his sterno-cleido-mastoideus muscle on the right side rigidly contracted; leeches and fomentations were applied to the mastoid extremity of the muscle; alterative medicines were prescribed; strict attention was paid to the bowels; and after some weeks his general health very much improved; still the muscle remained as rigid as ever. During the summer his father took him to London, and you were consulted. I believe he was advised to go to the sea, and a steel apparatus was recommended. The sea, I understood, was of service to him, but as the apparatus did not improve, and injured his back, it was, after some weeks trial, laid aside. A vigorous system of shampooing was then adopted, together with very active exercises. His health improved; he grew taller and stouter; and by great effort he could stand straight; but the moment he relaxed his efforts, his chin turned towards his shoulder, his spine became curved, and he relieved himself by resting on one leg.

"All remedial measures were at length abandoned, and this last half-year he was sent to school. His general health has continued good, but his sterno-cleido-mastoideus is just as it was."

Sometimes the head is drawn to the shoulder; sometimes it is moved to and from one side, with a rocking motion.

The hydrocyanic acid, taken internally and applied externally, seems to promise much benefit. What would be the comparative results of dividing the spinal accessory or the muscle itself.

1164. The following sketch is taken from Sir Charles Bell:—

"The condition of this woman is very peculiar: in her, common breathing inspiration is performed with a sudden spasmodic action; but she is also affected at intervals with more violent spasms, and her respiration is then hurried and distressing. On the commencement of a paroxysm, she bends her body slightly forwards, and thus prepares herself, as it were, for the attack; her nostrils are dilated widely, the angles of her mouth are dragged forcibly downwards, there is a constriction of the throat, and the shoulder and chest rise convulsively, as when a person has cold water poured upon the head; the inspirations are deep and violent, and are attended with a sniffling of the nostrils, the air being inhaled through them only, and not through the mouth. The fibres of the platysma myoides start into view, and there is quick rising and falling of the pomum Adami; the sterno-cleido-mastoideus and trapezius, on both sides, act powerfully, fixing the head and elevating the shoulders.

1165. "The spasmodic action of these muscles exists to a considerable degree constantly, yet it increases in paroxysms which last so severely for a few minutes that she is deprived of the power of speech, and seems to be almost suffocated. These paroxysms recur at irregular intervals. It was observed by the attendants, that when she was excited by walking about the ward or by replying to our questions, they returned more frequently.

1166. "She could move her head with perfect freedom when we requested her, but still the spasmodic action continued. She also raised either shoulder, or twisted her face to one side, when she was desired. This woman continued under the care of the physician for about a month, and was discharged cured."

1167. I have recently attended a patient, a young gentleman aged about twenty, who experiences attacks of a peculiar affection of the movements of *respiration*; he lost the power of articulation; on attempting to speak he was suddenly seized with a spasmodic action of the diaphragm, which induced a sudden *inspiration*, with a hissing noise as the air entered through the lips, and pain in the points of attachment in the

diaphragm. This affection yielded to attention to diet, and to the state of the bowels.

1168. These and other affections of the true spinal *motor* nerves agree in several particulars:—1, they are usually suspended during sleep (in this they differ from *similar* affections *excited* through the true spinal *excitor* nerves, which frequently come on during sleep); 2, they are redoubled by any cause of mental hurry or excitement.

1169. Notwithstanding what has been said, I consider it still a question important to determine whether any and which of these diseases have their origin in the excitor nerves, or in the true spinal axis?

I will conclude these observations by a few words relative to the pathology of

The Fifth Pair.

1170. Sig. Bellingeri considers the *fifth* to be a nerve of organic life, as well as of sensibility. M. Magendie speaks of it as influencing the nutrition and functions of the eye, &c. M. Serres views it as the nerve of instinct. Sir Charles Bell as a mere sensitive nerve. The view given of the subject in these notes is very different and far more comprehensive. I consider the fifth, in addition to its office as a cerebral nerve, or nerve of sensation, as forming a part of the excito-motory, and of the external ganglionic *systems*.

1171. But, besides these views of the function of the fifth pair, M. Magendie has discovered another. This nerve has a peculiar influence over the *senses*, as M. Magendie observes, in his "Precis de Physiologie," ed. 3, tom. i., p. 100.

1172. The same observations are made in reference to the sense of smell and of hearing.

These experiments are not the only evidence we possess of the *influence* of the fifth on the *vision*. In the "Archives Générales," tom. xxiii., p. 260, there is a case of *amaurosis* of the left eye arising, apparently, from caries, and the presence of a portion of a toothpick of wood in the first molar tooth of the left side, and ceasing nine days after its extraction.

1173. In an interesting case under my own care, a partial *amaurosis* of the right eye has arisen, apparently from caries of the upper canine tooth of the right side; it was augmented by unsuccessful attempts at extraction; it has not ceased, however, since the extraction was effected.

1174. These facts, with the similar results from wounds or tumours of the supra-orbitar branch of the fifth, appear to me to confirm the extraordinary experiments of M. Magendie.

1175. The effects of the division of the pneumogastric on the lungs and the stomach, as demonstrated by the experiments of Dr. W. Philip and Sir Benjamin Brodie, prove this to be a secretory nerve. There are no cases on record, I believe, with the exception of a very defective one by M. Cendrin, in which the pneumogastric was distinctly affected, and in which the influence of its disorganisation upon the lungs, stomach, and other internal organs was traced.

1176. There is still an interesting inquiry open to us relative to the defective development and nutrition of the internal organs and external limbs, &c., from diseases of the internal and external ganglionic systems.

1177. Some diseases are obviously affections of the internal ganglionic nerves; we have *augmented action*, for instance, of the liver and kidney, in the cholera Europæa, and enuresis; we have *paralysis* of the same organs in the cholera Indica, and in some cases of icterus, and in ischuria.

1178. I here close, then, my observations upon the Nervous System and its Diseases for the present. If they have interested and instructed you, if they have led you to reflect upon these interesting maladies, my object will have been accomplished.

I shall be still more gratified if you are induced to bear the subject in your minds, and assist me by your observations.

The subject is but *sketched*. Perhaps it can scarcely be said even to be sketched. It is full of promise in reference to anatomy, physiology, and practice.

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